

NEW
EXPERIMENTS
AND
OBSERVATIONS
W. UPON *Scarborough*
MINERAL WATERS,

Directing their farther Use
For the Preservation of HEALTH, and
the CURE of DISEASES.

By the late
Dr. FRIDERICK HOFFMAN,
Counsellor and Physician to the King of Prussia,
and Fellow of the ROYAL SOCIETY.

EXTRACTED
From his several ESSAYS upon this Subject, and
illustrated with NOTES.

THE SECOND EDITION.

To which is added, by way of APPENDIX,
An ENQUIRY into the CONTENTS, VIRTUES,
and USES of the

SCARBOROUGH *Spaw-Waters*;
With farther DIRECTIONS for examining any other
MINERAL WATER.

By PETER SHAW, M. D.

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EXPERIMENTS

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MINERALS

The following table shows the results of the experiments of the effect of the heat and the action of the acids on the various minerals.

THE SECOND PART

CONTAINING THE RESULTS OF THE EXPERIMENTS ON THE MINERALS OF THE SYSTEM OF THE ROYAL SOCIETY.

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THE SECOND PART

THE PREFACE.

THE Importance of the present Subject requires it to be laid, in one View, before the Publick. Physicians have been long divided upon the Nature and Use of Mineral Waters; but the new Light here given to the Affair, may, perhaps, lead to a Determination. Many Writers extol these Waters above measure; whilst others decry them with no less Vehemence. The Truth may possibly lie in the Middle. To preserve a Neutrality in stating the Question, it should be done, not from the professed Patrons of Mineral Waters, nor from the professed Writers against them; but from such discreet and intelligent Persons as endeavour to illustrate the Subject

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by direct Experiments and Observations.

*Dr. Lister and Mr. Boyle were not sway'd by the Authority of the Ancients in this Enquiry; but thought themselves free to examine all a-new. And in the same manner several Members of the Royal Society at London, and of the Royal Academy of Paris, have also proceeded.**

Dr. Lister enquired into Mineral Waters, and their Beds, as a Naturalist and a Chemist; threw out a number of fictitious Principles, which Credulity and slight Observation had loaded them with; examined into their Effects upon drinking; and after many Doubts and Scruples, allows them eminently serviceable in several Distempers;

* See the Observations of the *Sieur du Clos*, made upon the *Mineral Waters of France*, before the Royal Academy of Sciences at *Paris*; the Original printed at *Paris* in 1675, but translated into *English*, and printed at *London* 1684. See also the *Philosophical Transactions*, and *French Memoirs* upon this Subject.

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temper; tho' still to be used with Caution and Discretion, to prevent their proving prejudicial; whereto be apprehended they were inclined. *

Mr. Boyle drew up a comprehensive Set of Heads for the Natural History of these Waters; examined the specific Gravities of several; shewed the Insufficiency and Narrowness of the common Methods of examining them; made many Experiments to discover their Principles or Contents; enquired into their Effects upon drinking; and concludes, that Experience, upon a Course of using them, can best determine for or against them. †

Dr. Hoffman, after a long Series of Years spent upon the Examination of these Waters, as a Naturalist, a Chemist

* See Dr. Lister's *Exercitationes duæ de Pontibus Meditatis Angliæ*; the first printed at York, in 8^o. 1683, and the second at London, 1684.

† See Mr. Boyle's *Memoirs for the Natural History of Mineral Waters*; printed at London, 1685.

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Chemist and a Physician, declares them the most innocent, the most universal, and most serviceable of Medicines; not only from a Discovery of their Contents, their apparent Natures and Compositions; but from a successful Course of Experience, in Persons of different Ages and Constitutions. His Enquiries shew us an easy way of examining the Ingredients of Mineral Waters, or judging of their Efficacies, without dangerous Trials; and sets the whole Affair in an advantageous Light; wherein it had not before appeared, even after the Labours of the French Academy, Dr. Lister, Mr. Boyle, and other eminent Writers upon this Subject.

The Author's Abilities are known from his several Works; there appears an open generous Spirit in his Discourses upon Mineral Waters; and these Pieces, in particular, have been well receiv'd abroad. They were originally publish'd separate, at different times;

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times; but afterwards revised, improved, collected into one Volume; and in the Year 1726 reprinted at Ulme. They are here contracted, methodiz'd, and more particularly fitted to our Country, by a few additional Notes and Illustrations; so as to prepare the way for a particular Examination of the Mineral Waters of England; which was the principal View in publishing this Treatise.

Accordingly, at the end of our former Edition, there was added a short Appendix, containing a Plan for the particular Examination of the Mineral Waters of England; which Appendix is here dropt, and its place supplied by larger and more distinct Directions for executing the Design; with a Specimen of a more rigorous Enquiry than what Dr. Hoffman has given. For the thing we mean, is not any hasty or superficial Account of a Mineral Water; but a faithful inductive

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ductive History of every medicinal Spring in England.

It is, perhaps, a more difficult matter than Men usually imagine, to give a just Account of the Contents, Virtues and Uses of any Mineral Water; especially, when those who attempt it, or those who judge about it, have not been versed in the making of philosophical and chemical Experiments.

Hence it may, probably, appear strange to many, that the Queries proposed in our Enquiry should be so numerous, the Apparatus so large, and the Method aimed at so rigorous: Tho' all this will easily be excused by those who know what Errors have been committed in the like Attempts, for want of a competent Number of leading Questions, exact Instruments, and a suitable Habit of using them.

The End here intended, is to point out a way of bringing physical Enquiries

quiries to physical Certainty; and to try, if, by using the Art of Induction, more of the nature of Mineral Waters may not be discovered than has formerly appeared: As the Reason, why so little has hitherto been done in this way, seems owing to the want of an adequate Method of Enquiry, capable of directing Experiments, verifying Particulars, bringing them to Order, and manifesting the Result.

The direct Enquiry itself into the Scarborough Water is indeed but barely begun; and if ever compleated, will possibly be the first Example that has been set, of a full, inductive History of any mineral Water.

The Sketch being at present imperfect, an Objection may easily arise against the publishing of it in a Form so disadvantageous, both for the Reader and Author: On a Supposition, that it might have been better to have finished the Design by degrees, and at
a length

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length to have given the Result in a direct and concise manner; without entering into a Detail of the Apparatus, and shewing the several Steps of the Procedure.

To this the Author replies, that he conceives it much more advantageous for the Publick, to give the Ground-work of the Art of Induction, than to dress up a few Discoveries after the most agreeable manner that could be invented: As this Art is of infinite use, and leads directly to a sure Method of making all the Discoveries in Nature that Mankind can reasonably hope for. And tho' the Author pretends not to know much of this Art, yet he presumes it may best be taught by shewing the first Rudiments of an Enquiry conducted according to its Rules; and therefore would chuse, for the present, to publish the Out-Lines of a History, rather than a finished Piece on the Subject, tho' he were, as he is not, able to give one.



INTRODUCTION.

1. **T**HERE are three things essential to a Physician. The first is, a Knowledge of the true and original Causes of Distempers; so as clearly to conceive in what manner, and by what pernicious properties such Causes act, and disturb the Frame of the Body, or the Motions necessary to Life and Health; and how, through the Connection and Dependence of one part upon another, these Causes frequently produce others, and a Variety of Symptoms. The second is, after a perfect historical knowledge of the circumstances, the causes and the symptoms of a disease, to discover the proper Remedies for the cure. The last thing is, a Knowledge how to administer and apply these remedies, with prudence and discretion, according to different circumstances, in the proper Season, Dose, and Order.

*The three
Essentials
in a Phy-
sician.*

2. And as the Art of curing, and preventing Diseases, turns entirely upon the Remedies which the Physician uses, as so many Instruments; he must of necessity, to apply them skilfully, be well acquainted with their Virtues, Powers, and Principles of Action, and know what Changes they will produce in the Body, whilst they perform their Office; otherwise he proceeds empirically, and can have no solid hopes of Success.

3. From a long Course of Experience, I may venture to pronounce, that the great Secret in Medicine is to be master of a few select and well-

*The chief
Secret in
Physick.*

prepared Remedies ; to understand their Virtues, Powers, and Effects in different Constitutions ; and to be well assured, in all cases, what they will and what they cannot do. He, and only he, who has this Talent, both in Theory and Practice, can be allowed an accomplished and successful Physician. Accordingly, it was excellent Advice which *Damascenus* gave to his Son, " Let the Remedies you employ be few, " and certain ; for the use of a Multiplicity so " distracts the Senses, that a Physician can safely depend on none."

The real
Virtues of
Remedies,
why so
little
known.

4. But it is to be lamented, that of the vast Number of Physicians, so very few should thoroughly understand, as they ought, the Powers and Effects of the Medicines they prescribe : Whence proceed those infinite Volumes which are stuffed with the *Materia Medica*, infinitely combined. And though the Authors launch into high Encomiums of the Virtues, Uses, and Excellencies of these Remedies, in particular Distempers ; yet Experience, which is the true Test of all things, declares such Praises false ; and that both the Patient and Physician are hence generally disappointed in their Expectations.

5. The Reason why this useful, and necessary Acquaintance with the Virtues and Efficacy of Remedies is so much slighted, seems principally because the Antients, and many of the Moderns, were totally ignorant of the Elements of chemical Philosophy ; so that they could not properly examine the Texture and Composition of the Simples ; nor arrive at the Art of discovering the Principles whereof they consist : Whence they never obtained a previous Knowledge of their Virtues, before they prescribed the things.



6. Again, Physicians prevent themselves from learning the true Virtues and Effects of the Simples, by the crowded manner, variety, complex mixture, and great unsteadiness wherein we prescribe them: which renders it impossible to form a true Judgment of the Virtue and Power of any one Ingredient. And being also destitute of a sure Foundation whereon to rest, or fluctuating in uncertainty, 'tis customary with us, if a Medicine has not presently the desired effect, to order other Compounds from the Shop; and these proving ineffectual, others again: insomuch that if the Patient should happen to recover, we know not, in such a variety of Medicines exhibited, to which the Cure was owing; so as upon the like Occasion, successfully to employ the same again. And hence the Lord Bacon very justly calls Multiplicity of Remedies the Child of Ignorance; and, with exact discernment, censures Physicians in these apposite Words: "To see the daily Labours of Physicians in visiting, bustling and prescribing to their Patients; a Spectator would imagine that they diligently prosecuted the Cure, and went directly in a certain beaten Track about it: But whoever looks attentively into their Prescriptions and Directions, will find that the most of what they do is full of Uncertainty and Irresolution, without any certain view or foreknowledge of the Cure *."

7. Of this Truth we have a signal Instance in the business of Mineral Waters: which though famous for so many Ages, and recommended by thousands of eminent Examples, are nevertheless discredited by the Ignorance and Unskillfulness of Physicians. For, to examine the Writings both of the Antients and Moderns

And particularly the Virtues of Mineral Waters.

* See *De Augment. Scientiar. & Histor. Vita & Mortis.*

upon the Subject, they give us nothing but amusing Fables about the Principles wherewith they phantastically imagine these Waters impregnated; insomuch, that there is not a Metal, a Mineral, or a Salt, excluded their Composition: and hence they judge very doubtfully about their Uses; and know not from whence their Virtues proceed.

*The vulgar
Notion
of these
Waters.*

8. Thus it has been a current opinion, that Mineral Waters abound with a vitriolic Acid; and upon this account Physicians have absolutely forbid the use of Milk in the drinking of them. Many have asserted the Vitriol of Iron to be their essential Ingredient; and to such a length some have carried the Notion, as to assert they contain Matters disagreeable and prejudicial to the human Body. In short, such kind of erroneous Opinions are deeply fixed in the Minds of most Physicians; whence they generally fancy these Waters unsafe and violent in their Operation; and therefore forbid all such Patients the use of them, as are either weak, very young, old, of infirm *Viscera*, or phthysical: and pretend that they are scarce ever to be employed but in obstinate and inveterate Cases.

*The true
Notion
thereof.*

9. Upon observing the Prevalency of this Notion, I diligently examined most of the medicinal Waters in my own Country, by various chemical, and philosophical Experiments; as by Mixture, Distillation, Exhalation, Weight, &c. in order to discover their Nature and Principles. And in the issue my Labour was not disappointed; for, upon an exact Scrutiny, I found that all the *Acidulae*, or cold and brisk mineral Springs, contain not an Acid, but a pure alkaline Salt; which would raise a Conflict with any Acid: That no solid Vitriol is procurable from any of these Waters: That Milk mixes kindly, agrees well,

well, and proves of service in a Course of the *Acidule*; so as to be thus drank, with the greatest safety, even by phthical Persons: That the Virtue of purging Waters depends upon a certain neutral, deterfive Salt, composed of a subtile, chalky, or calcarious Earth, and a mineral Acid: That both hot and cold Waters have a Correspondence in their Principles and Virtues; and are neither prejudicial to the weak, young, or old, not even Women with child, or Persons recovering from acute Distempers: And lastly, that the efficacy of mineral Waters, in opening inveterate Obstructions of the *Viscera*, &c. has a great Dependence upon the Quantity and Goodness of the mere Water; and that many of them have not the least pernicious Quality. And to set this matter in its just light, we shall here previously sum up the medical Doctrine whereto our numerous Observations and Experiments lead.

10. (1.) And first it appears, that mineral Waters, both of the hot and cold kind, are of such Virtue and Efficacy, for the Preservation of Health, and the Cure of Diseases, as in the highest degree to exceed the Shop remedies, prepared by the nicest Art. And we are well assured that this Fact cannot be disputed, but by such as derive their Arguments from their Ignorance or Indolence; and therefore are no way competent or experienced Judges in the Case. *Their Virtues in general, sum'd up.*

11. (2.) These Waters approach the nearest of any thing in Nature to what has been so much searched after, an universal Medicine, suited to the Cure of all Diseases: whence there is no occasion for any such laborious Enquiry, whilst Waters, adapted to all kinds of Disorders, spontaneously offer themselves. And I would fain know whether any Physician, of

practical Knowledge and verified Experience in his Art, can say of any other Medicine, what we certainly know to be true of Waters, viz. that they effectually cure, both with Expedition and Safety; yet occasion no loss of Strength, but operate gently by all the Outlets of the Body; and thus discharge at every Pore, the Matter which generates, and forms Diseases. For, these Waters not only readily dilute, propel, and carry off Collections of impure Humours, lodged in the Stomach and Intestines; but likewise admirably promote the Discharge of all peccant, saline, and unctuous Matter, by the Conduits of Urine; and at the same time breathe out the more subtile and rarified pernicious Particles, by that general Strainer of the Body, the Skin.

12. (3.) These Waters, besides their Power of evacuating, are also possess'd of a singular alterative Virtue; insomuch, that there is no other Remedy, hitherto known, so fit for dissolving viscid and sily Humours in the Body; for diluting and tempering such as are sharp and corrosive; for correcting and changing such as are acid and austere; and for opening and breaking away Obstructions and Coagulations in the finer Vessels. Add to this, that they have a most desirable strengthening Virtue; whereby they nobly brace up, and recover such solid Parts of the Body as have lost their natural Tone and Springiness, or are become slack and remiss. And, what is more extraordinary, they produce all these good Effects without occasioning any subsequent Mischief; and therefore, as mentioned above, may, with the utmost Safety, be given, not only to Persons in a state of Health; but even to those in the weakest Condition, Women in Child-Bed, old People, and Children. In short, they have also this particularity, that they

they may be innocently and advantageously used in different Constitutions, and Ages, at all Seasons of the Year ; not excepting the Winter itself.

13. (4.) What is still more wonderful, but no less certain, every single capital mineral Spring seems endowed with quite different Virtues ; so as to produce opposite Effects. Thus ; if the Excretions of the Body are too large, these Waters check them with safety ; or if they are too small, the very same Waters will effectually increase them. Again, if the first Passages, particularly the Stomach and the *Duodenum*, be over-loaded with a bilious Matter, they, without violence, discharge it by Vomit ; and, on the contrary, soon cure that stubborn and violent Vomiting wherewith hypochondriacal Persons are sometimes afflicted. So likewise, if the menstrual or hæmorrhoidal Flux be too large, obstructed, or observes not its regular Periods ; there is no better Remedy hitherto discovered than Mineral Waters, for bringing these Disorders to rights.

14. (5.) Another signal Instance of Design, Wisdom, and Goodness shewn in mineral Springs, is an Advantage they have above most other things ; viz. that they are not very apt to lose their Virtues, or fall to Ruin and Decay. * For though this has sometimes happen'd, yet the more capital and serviceable Springs, of medical Use, have certainly retained their Virtues, through the Course of many Ages ; and afforded a sufficient Quantity of Water, even in the hottest Seasons ; whilst other common Springs have been dried up. They have also continued to abound with the same Quantity of Principles, or Ingredients of the same Quality, in an equal Proportion of the Water. And lastly, though the Bowels of the Earth, through which these

* See below §. I. 21, &c.

Waters run, are pregnant with Metals and Minerals, some of them prejudicial and poisonous to the Body; yet the Waters of these Springs dissolve and drink up nothing of this kind: but, as if directed by an appetite of Choice, impregnate themselves with only such Principles in their passage, as render them highly agreeable to the Solids and Fluids of the human Body.

15. Since, therefore, there are so many Advantages derivable to Mankind from medicinal Springs; whence they were held sacred by the Antients; who can help wondering at the supine Indolence and Neglect both of Philosophers and Physicians, in not examining into their Principles, Operations and Effects? The greatest part of the Authors upon this Subject appear to have wrote hood-wink'd; so as not to see the real Principles and Ingredients of these Waters: but on the contrary, to have imagined in them Matters whereof they could not trace the least marks. Whence it has happened, that not only the Physicians upon the spot, but those likewise of other Countries, who had not the opportunity of examining our Waters, have held them suspect, precarious, or dangerous; and therefore advised their use only to the robust, the vigorous, and the healthy: being very apprehensive of doing mischief at least, if not occasioning Death, by a Remedy which they thought abounded with the Principles of so many Minerals, opposite and destructive to the Body; unless all its parts were perfectly sound. In this point, however, such Physicians have not acted consistently with themselves; for their Custom has been to make these Springs a last Resource in the Cure of chronical Disorders; after all other Remedies had failed: as if Persons, who had so long laboured under inveterate Diseases,

Diseases, could be supposed to have their *Issue* found and untainted. Such Physicians, therefore, notwithstanding all the Darkness and Distrust which may hang about their Minds in this matter, must acknowledge that Mineral Waters cannot, at least, but be innocent, if they here do no mischief; or highly serviceable if they effect a Cure, in Bodies so weakened or worn out by Distempers: though they may not understand the Reasons whereon the thing depends; which it will be the business of the following Sheets to unfold.

16. And if I shall have made any useful Discoveries in this Subject; what led me to them was a firm resolution to take nothing upon trust; nor measure the skill of Physicians, by popular opinion; but resolving my self to try, as far as my abilities went, and examine every thing by the rules of Reason. And finding, by Observation and Experience, the superiour Excellence and Usefulness of Mineral Waters in the Art of Medicine, I thought my self obliged to prosecute my Enquiries, with a caution and exactness proportionable to the importance of the Subject. Thus, by with-holding my assent to the received notions upon this head, and coming personally to examine into the true Nature, Principles, and Virtues of these Waters, by the means of chemical and philosophical Experiments; I found the greatest part of what had been said of them by Authors, to be false and fictitious. And being once thoroughly convinced of this, I thought it incumbent upon me to oppose the Errors every where strongly prevailing to the disadvantage of the Art I profess; and to support my own Discoveries with all the light and strength of Reason I could give them. And in the course of these my Enquiries and Endeavours,

yours, I have happily discovered certain Springs of uncommon virtues; and advantageously introduced them into Physick. If others will proceed in the same, or a better manner, I doubt not but their Labours will be crowned with the like or better success: which is what I earnestly wish, for the benefit of Mankind.

SECT.

S E C T. I.

Of Water in general: Or, the Ways of determining the Wholesomeness, Goodness and Excellency of all Waters; without any dangerous Trials upon the human Body.

TIS a great unhappiness that Men should lightly esteem those things, which, though ever so necessary and useful, are held cheap, or common; and not examine into their Natures, Properties and farther Uses. * Thus, tho' Mineral Waters are certainly endowed with great medicinal virtues, even so far as to render all other remedies in a manner unnecessary; yet they have been very little examined, or used, as they deserve. We cannot, therefore, but earnestly recommend the due prosecution of this Subject to all such as are more concerned for the Health and Prosperity of Mankind, than for establishing an Art upon human Infirmities. To discuss this Matter in some tolerable degree, and enable People to assist in the Cure of their own Diseases, is the intention of the present Essay; wherein we propose to deliver

Mineral Waters to be generally understood.

* Mankind frequently want to be admonished, that the commonest and largest Masses of Things are to them most useful, and most necessary to be understood; as Water, Earth, Air, Fire, Wood, Clay, Coal, &c. &c. and that the discovery of a new property here, or a new way of applying any of these common things, may be most extensively useful. Whence it might be no bad Rule for Philosophers to begin their Enquiries with the commonest things, that Nature affords in the greatest abundance, to the end that numbers may receive the advantage.

liver our Observations in an easy and familiar manner, for a general Good.

2. All Countries abound with medicinal Springs, suited to the Cure of numerous Diseases; whilst the Natures, the Virtues and the Uses of such Waters often remain unknown to the Physicians and Inhabitants of those Countries. And tho' it has been a general Practice to frequent certain Springs at particular Seasons of the year; yet the Physicians and others, who have wrote in commendation of their Virtues and Uses, have commonly done it in an ignorant, illiterate and inartificial manner; without the least tincture of what is herein so requisite, a Knowledge of chemical Operations, and the way of making judicious philosophical Experiments; insomuch that they have given us strange dreams of Waters impregnated with Gold, Silver, Antimony, Arsenic, Sealed-Earth, Sal-ammoniac, Bitumen, and a thousand other things; in direct contradiction to Experience and Observation.

3. No less preposterous has been their manner of prescribing such Waters; which they do in the perfect manner of Empiricism, without the least regard to their Virtues and Efficacy, or the causes of the Distemper: so that Mineral Waters seem the principal and more immediate seat of Quackery *. And if the rational and philosophical Physicians, as they affect to be called, desire in earnest to clear their Conduct, and wipe off this reproach; let them shew, by their Practice, that the Virtues and Efficacy of Remedies do not more depend upon the Remedies themselves, than upon the disposition of the Bodies whereon they are intended to act. And when

* The Reader may please to observe, that the Scene is all along Germany, not England.

they meddle with Mineral Waters, or take upon them to point out and direct their Use; let them not praise or dispraise them in general terms, but enumerate the necessary Circumstances and particular Cases wherein they may or may not be serviceable; and lay down such Rules and Observations as tend to some certain Issue. In order to lead them the way, we will here proceed, not upon general Conjectures; but write from a long series of Experiment and Observation.

4. And first, we understand by Mineral Waters, not only such hot and cold Springs as have already acquired a Reputation, and are therefore much frequented; but likewise all others that manifestly partake of a saline or mineral Nature: of which there are infinite numbers; as if Providence had dealt out, with a liberal hand, ready and easy Cures for all the Distempers with which Men are afflicted*. Our primary Care shall therefore be to deliver Methods and Rules of examining the Wholesomeness or Unwholesomeness, the medicinal or pernicious Properties, of all kinds of Waters; without the necessity of making any dangerous Trials with them upon the human Body.

Mineral Waters, what.

5. By the Term Wholesome we mean that which no way hinders or impairs the natural Actions of the Body; but has a direct tendency to promote, strengthen and confirm them: and of this kind are all those things which forward, continue and secure the Offices and Actions of the Parts of the Body. The Cause of this depends upon the natural Frame and original Structure of the Parts; and, in a more active and eminent

Wholesomeness and Unwholesomeness, what.

* *England* abounds in Mineral Springs of various kinds; and any one may be easily instructed to discover them, and examine their Virtues and Uses; as will appear in the course of this Work.

eminent degree, upon that extremely fluid and fine Matter of the Body, called by the name of Spirit; which resides in every part; and, so far as the present anatomical Discoveries reach, is principally separated in the fine Canals and winding Vessels of the Brain and spinal Marrow; and thence convey'd to all the parts by the porous and spongy substance of the Nerves; in order to give Strength, Vigour and Motion to the Solids; Mobility, intestine Motion, and a spirituous Nature to the Fluids; to preserve their Texture entire, and defend them from corruption. So long as this Fluid remains in its due and proper State, the Body is healthy, firm and stable; and all the Actions and Offices of the natural Life duly and properly exercised and performed. But as the natural Actions of Life cannot remain perfect and entire, unless the humours are rendered sufficiently thin and fluid, to flow thro' the smallest capillary Vessels; and unless the useless drossy parts are separated and discharged by the open Orifices of the Vessels, both of Secretion and Excretion; whatever preserves the Juices in their entire and perfect State, and promotes these Excretions in the respective Vessels, is deservedly called by the name of healthy or wholesome; as, on the contrary, we justly term that unhealthy or unwholesome, which is opposite to the Nature, of the Spirits; prevents their Separation, Formation and Recruit; disturbs their Motion, renders the Juices thick and sily, shuts up the finer Pores and Passages of the Body, and stops, or retards the business of Secretion and Excretion*. Having thus settled the precise Notion of wholesome and unwholesome, and shewn whereon the

* This Matter is sagaciously established by the Lord Bacon, in his *Natural History of Life and Death*, and prosecuted by many of the modern Physicians; but especially by Dr. Boerhaave in his *Institutiones Medicæ*.

the thing depends; we proceed to enquire into the Causes of Wholesomeness and Unwholesomeness in Waters: and the better to conduct us herein, we shall examine their various Contents, or the different parts whereof they consist.

I.

OF THE SPIRIT IN WATERS.

6. All Water appears to the Eye as one simple uniform Fluid, consisting of parts of the same kind; whence it was by some of the Antients, and particularly *Thales*, esteemed an Element, or the first Matter of all things. But when we come to examine more narrowly into it, Water will be found a Composition of Bodies different in Kinds and Properties. Thus 'tis evident, that Waters differ greatly amongst themselves, both in taste, weight, and many other particulars; so that some of them are fitter than others for particular Uses, and the common Occasions of Life. This difference plainly shews, that Water is not a body of one and the same constant nature; but containing different Ingredients, or a different Mixture or Proportion thereof, in different Springs, Rivers, &c. And to examine the real Principles of Water, in general, this Fluid appears from Experiments and Observations, to be a Composition (1.) of a very subtile or elastic Matter; or in all probability an extremely moveable or subtile *Æther*, * whereof there are numerous Instances; (2.) of Moisture, or what, for distinction's sake, may be called Elementary Water; and (3.) of a solid Body, either of an earthy or saline nature. This *Æther* appears to be

The Contents of Waters.

* Let not this be supposed a fictitious Principle, till all the Experiments hereafter produced to manifest it, have been carefully considered.

be the Cause of the intestine Motion of the parts of the whole Fluid; the Cause of the facility wherewith the Globules roll over each other; the Origin of its truly spirituous part; and what preserves it from Putrefaction. The elementary Water, which has the greatest share in the Composition, serves as a Vehicle to lodge, detain and convey the subtle Matter; and is composed of very polite, smooth and yielding particles; by means whereof it readily enters the pores of Bodies, and drinks in and closely embraces any particles of fine earthy or saline Matter. And, accordingly, this fine earthy or saline Matter seems rather to be an accidental than a real constituent part of Waters; tho', in effect, there is no Water to be found that does not contain some portion of a dry and solid Matter. For if the finest and purest Water be ever so often distilled, it still leaves some small quantity of a dry and solid matter behind. So likewise if the purest Water be froze into Ice, and this Ice be melted again, it constantly leaves a gross, earthy part behind*.

7. The different degrees of Wholesomeness and Unwholesomeness in Waters, together with their medicinal Virtues, may properly be judged of from the Nature, Mixture and Proportion of their Contents, or the three different parts into which we have distinguished them, upon the footing of a philosophical Resolution, or gentle chemical Analysis; which does not alter their Nature. And in fact, we find, that Mineral Waters differ considerably according to the different Proportions of Spirit, or ætherial elastic Principle they contain; which either in a greater or less degree is found in them all. But they

* Some late Philosophers have produced Experiments and Reasons to shew, that the purest Water is no other than a fluid Earth. See in particular *Boyle*, *Becher*, *Newton*, and *Stahl* upon the Subject.

they differ much more in respect of their solid; saline, or earthy Element: for, as most Waters, in their courses thro' the Earth, imbibe and become impregnated with the Salts, or earthy, mineral matters they wash; they must of necessity, when they come to the spring-head, retain many of the fine particles thus licked up in their passage. And, by proper Experiments, to discover or manifest to the senses, these more accidental Ingredients of Mineral Waters, which distinguish one Spring from another, and give particular Virtues to them, is the business of natural Philosophers and Physicians.

8. The first Enquiry to be gone upon, is the *The Signs* Marks, Signs and Characters of Wholesomeness *of Whole-* and Unwholesomeness in Waters. And here we *someness* lay it down as a certain rule, that those Waters *and Un-* are most excellent, and powerful in the Cure of *wholesome-* Diseases, which are the most spirituous, or hold *ness in* the most of what we call the fine elastic part. *Waters.*

And this capital property may be discovered by many infallible marks. Thus their Lightness, *Specific* or less degree of specific Gravity, is a sure test *Gravity of* and standard of their Spirit: for as Air and Æther *Waters.* prove principal Causes of Rarification; so do they likewise of Levity. This Position receives abundant Confirmation from Experiment, and has been well observed by a Writer on the Spaw-Waters, * who relates, " That the cold Springs " which are fullest of Spirit, or, as he calls it, " sulphureous Exhalation, prove much the " lightest upon the balance; as remarkably ap- " pears in the Waters of the Spaw, taken from " that Spring called *Savenir*, at some distance " from the Town; where the Water is much " lighter, stronger, and quicker in its operation, " than that taken from the Spring in the Town.

C

" But

* *Geringius in Descriptione Spadan.* p. 15.

“ But this strongest and most spirituous Water
 “ cannot be carried from the spot without great
 “ diminution of its Virtue ; nor so much as be
 “ brought half a mile to the town without losing
 “ its Spirit ; and consequently, increasing its spe-
 “ cific Gravity.” And this is not only true
 of the Spaw-Water, but confirmed, by Expe-
 rience, of the Waters of all cold and brisk Mi-
 neral Springs.

9. Precisely to determine the specific Gravity
 of Mineral Waters, is a matter of considerable
 nicety ; but may readily enough be done for
 Practice, by means of a well-made Water-poise,
 with a hollow Ball and Stem ; or a hollow gradu-
 ated Cylinder of Brass ; or still better by means of
 a Glass-Tube fill'd with Water, the open end
 whereof is plunged into a Glass of other Water :
 for a Fluid, as is well known, immersed in ano-
 ther, specifically lighter than it self, will descend,
 and the other rise in its place. So that, for ex-
 ample, if a glass Tube of Water be plunged into
 Wine, the Water will sink out of the Tube, and
 the Wine rise up : which suggests a very agree-
 able way of trying the specific Gravity of Waters ;
 and at the same time entertaining the Eye with
 a sight that demonstrates the thing. For if we
 suppose any difference in the Gravity of two Wa-
 ters, and desire a Proof thereof ; 'tis but tinging
 that imagined to be the heaviest, with Saffron,
 Cochineal, Brazil-Wood, or the like ; filling
 the Tube therewith, and inverting it into a Glass
 of that supposed the lighter. But several mecha-
 nical Instruments might be invented to determine
 this matter in a different manner. However,
 great caution must be had in the use of the hydro-
 statical Balance, and the common Water-poise ;
 which, tho' they may serve very well for exa-
 mining the specific Gravities of Wine, Beer,
 common

common Water, salt Water, Lixiviums, and the like; yet such Experiments are very apt to miscarry, in examining the Waters of cold and hot medicinal Springs, on account of the copious elastic Spirit these Waters contain; whence they are ever apt to rise in bubbles about the Instrument, and buoy it up *.

10. The Lord Bacon judges the best Water, for all common uses, to be that which evaporates fastest by boiling over an equable Fire; and experiment confirms the Observation: for the greater the quantity of Spirit lodged in Waters, the more they are internally agitated, expanded and rarified: and the smaller or more subtile the particles of the Water prove, the sooner the whole exhales, or flies off in vapour; principally upon account of the internal Motion. Hippocrates, in like manner, pronounces that to be the lightest and best Water which is soonest heated and soonest cooled. This Assertion is likewise supported by Reason; especially if we allow, what has been anciently, and of late, rendered exceeding probable, that Heat is no more than a violent shuddering motion of the Æther; whence the more of a fine spirituous ætherial Matter is contained in Water, the sooner it grows hot, or comes into such a kind of intestine Motion. And when Water, once heated, suddenly grows cool again, this also is an indication of its lightness; as the cold Air enters easier into bodies of a light and spongy texture; and thus puts a stop to the shuddering Motion, or cause of Heat; than into dense and close Bodies, which therefore retain their Heat longer.

11. Again, those are certainly the wholesomest and most excellent Mineral Waters, which, when

The Goodness of Waters known by their heating, cooling, and their Spirit.

The Bubbles they afford.

C 2

* See, for Directions in this particular, Sect. II. *ad finem.*

when taken up at the Spring-head, discharge the greatest quantity of Bubbles; that first collect themselves at the bottom of the Glass, then rise in a cluster to the top; or else beset the rim of the Glass like so many Pearls. For, indeed, these Bubbles are nothing else but the subtile, æthereal substance residing in the Pores of the Fluid: whence, as the natural Pressure of the Atmosphere cannot hinder the expansion of the Water; they immediately, upon the motion of the Liquor, endeavour to extricate themselves and fly off. And hence it is, that the brisk spirituous Waters of cold Springs, when kept in a Bottle, of which they fill only two thirds, for example, coming to be disturbed, or briskly agitated, and then opened of a sudden; they with great force emit a pure Vapour: or if filled to the neck, the Water thus flies out, to a great height, in a considerable quantity. For by such shaking, the fine elastic substance contained in the Water is put into a very brisk Motion; and its Spring or Expansion being before hindered by the stopple, as soon as that is removed, the Vapour breaks forth in a sudden gust, and sometimes violently tears away a part of the Water with it. This same spirituous, or elastic Æther, is also the cause why the narrow-necked stone or glass Bottles, that are filled to the top with the brisk Mineral Waters of cold Springs, often burst: which is a thing well known to those who have dealt in the Pyrmont Waters. For thus Bottles of very great strength, and well secured at the top, have been broke to pieces; especially when they were set near the fire, or in a warm place.

Waters examined by the Air-Pump.

12. We may derive another mark of the Excellence of Mineral Waters, from a curious Experiment of the Air-Pump. For when a Glass of such Water, rich in medicinal Virtue, stands

stands in the exhausted Receiver, all the subtile and spirituous parts of the Water immediately rise and bubble up in Clusters to a considerable height; thus exhibiting a beautiful Appearance: which gives us another Method of trying the Virtues of medicinal Waters, by the Eye; and gaining a certain Proof of their subtile and elastic Particles. For such Liquors as contain a larger quantity of Spirit, which all volatile, urinous Liquors do, throw up numerous Bubbles in the exhausted Receiver; whilst those that contain less spirituous substance, afford but few. Whence 'tis plain, that the Waters which bubble violently *in vacuo*, are of a much more subtile and spirituous nature, than such as there bubble but little. For these Bubbles become visible upon no other account, than because the weight of the external Atmosphere, which kept them down, is here by the Air-Pump taken off; and leaves the elastic Spirit at liberty to expand, fly off, and visibly exert it self.

13. The better to establish and confirm the actual Existence of this spirituous Part in Mineral Waters, we will here subjoin a few considerable Observations. And (1.) nearly all the Waters of cold Springs, especially those of a brisk, pungent nature, being drank at the Well-head, are thus allowed to be much more efficacious than when carried to any considerable distance before they are used. And the Reason hereof is evident: for as the Waters are violently shook in the carriage, and rarified by an internal Commotion, they open an easy Passage for this subtile, elastic, spirituous Part to escape and forsake them.

Observations on the Spirit of Waters.

14. (2.) 'Tis also found necessary, exactly to stop down the Bottles, containing these brisk Mineral Waters, for Carriage and Exportation; and unless this be done, they lose not only their

peculiar Smell and Taste, but all their particular and spirituous Virtue: as plainly appears from the Pyrmont, Spaw, and all other brisk Waters; which being exposed to the open Air, lose all their Taste, Quickness, spirituous Parts, and Efficacy; grow flat, and leave a thick, dreggy, and exhausted Liquor behind.

15. (3.) Nor is it sufficient that the Bottles be well stopped, unless but little space be also left for the Air at the top, to possess; which would otherwise spoil the whole. For there is nothing in Nature that disturbs and corrupts the Mixture and Texture of Liquors more suddenly than the common atmospherical Air: as appears plain from the instance of Wine; which when kept in Vessels but half filled, presently grows flat, dead and musty. Something of the like kind also happens to distilled aromatic Oils; which being exposed to the Air, grow thick, deep coloured, and change their fine Odour to that nauseous one of Turpentine. So, pale volatile urinous Spirits, likewise, acquire a yellow or red Tincture, if the Air comes at them. And in all respects, the Air has a powerful influence upon Liquors; as being endowed with a brisk Motion, whereby it easily lays hold of, and carries off with it, all the subtle, most moveable and volatile particles of the Fluids; and by its own intestine Motion changes and destroys the texture of their Parts, whereon their particular Nature, Properties, Taste and Odour depend. And this is remarkably the Case in Mineral Waters; to which nothing is so prejudicial as a free access of the Air: inasmuch that the most effectual of them, when exposed thereto, become perfectly changed in their Nature, and can afterwards scarce be known for what they were:

were: so inactive, sluggish and indolent they thus become.

16. (4.) Medicinal Springs much sooner lose their virtue in a hot Air, than in a cold one; whence these Waters are more advantageously carried from the Spring-head to other places, by night, and in a cold Season, than by day, or in the heat of Summer. And for the same reason, they are best drank somewhat early in the morning, at the Spring-head, than towards noon: because the external Heat, by increasing their internal Motion, dissipates their fine and most efficacious Part, and carries it off into the Air. Cold, on the contrary, by contracting and pressing the Water somewhat inwards, rather helps to unite this fine Spirit, and detain and preserve it in the body of the Water.

17. (5.) It is still a more eminent instance to our purpose, that not only such Mineral Waters as have been long exposed to the free Air, but in a much greater degree, those that have once been boiled, entirely lose their primary medicinal Virtue, Taste, and Spirit. And here it requires an attentive Remark, that many Waters which turn inky with the powder of Galls, alter not their Colour with the same Powder when their spirituous substance is exhaled, or after the Water has received heat at the Fire: which is an evident sign, that, together with their Spirit, they lose a certain volatile mineral Principle. Whence it must be noted as an absurd and pernicious Error in those Physicians, who advise their Patients to use the brisk Mineral Waters of cold Springs, after being warmed in an open Vessel at the Fire; as by this Procedure the peculiar Virtue expected from them, which intirely depends upon this spirituous Part, is lost; and the Mineral Water rendered no more serviceable than common Water: For altho' these warmed Mineral Waters

may have their use ; yet he will be strangely deceived, who expects more from them in such a state, than from common warmed Water. But for those who cannot bear to drink these Waters cold, as several cannot who have weak Stomachs, and weak Nerves ; the best way of warming them, is, by putting the containing Bottle, close stopped down, into a Vessel of heated Water, so as to prevent the Avolation of the Spirit. But the Bottle, tho' strong, will thus be apt to burst, with great Violence, unless a pin-hole be first made in the Cork. *

18. (6.) It is farther observable, that all brisk and sprightly, cold Mineral Waters, if mix'd with Rhenish Wine, or any other tart Liquor, presently make a considerable Ebullition, especially if Sugar be added, and stirred in with the rest ; which thus affords an agreeable sight, by throwing up an innumerable quantity of Bubbles to a considerable height ; whilst the white, frothy head of the mix'd Liquor discharges a copious Vapour, that may be felt with pleasure by the Drinker ; insomuch that there are many who take delight in drinking Rhenish, or other small and tart Wine, thus mixed with a brisk Mineral Water. And this Experiment has occasioned several to observe, that the better these Waters are, the greater ebullition and frothing they produce, upon mixing with tart Wine ; and, on the contrary, that those which are weak, sluggish, insipid, exhausted, or any way destitute of Spirit, occasion not the least internal struggle with the same. This Conflict and Ebullition is entirely owing to the acid part of the Wine, mixing with the subtile Earth, of an alkaline Nature,

* It is a safer and better way to heat a small proportion of the same Water, and put it to a Glass of the fresh, at the instant of drinking,

Nature, lodged in the Water. For there is scarce any of these brisk Mineral Waters but make an Effervescence upon mixing with a powerful Acid: which is a plain Demonstration that they contain a certain, not acid, as has been phantastically imagined, but alkaline Principle. And therefore, whilst the Acid of the Wine here acts upon the Alkali, the spirituous Parts of the Water are put into motion; and, as in all similar Cases, (which in Chemistry are extremely numerous,) endeavour to make their escape with violence; and thus collect into Froth, and breathe out a potent Vapour.

(7.) 'Tis an Observation of considerable moment, that when these brisk Waters are bottled, the most efficacious Part, both for promoting or strengthening the Faculties of the Body, and raising an Ebullition with thin, tart Wines, lies towards the top of the Bottle or Flask; far excelling that which remains below: for the ætherial elastic Principle of these Waters, by reason of its extreme Subtlety, Levity and Mobility, ever strives to get uppermost.

19. (8.) Lastly, 'tis not unpleasant to observe, when these brisk spirituous Waters are fresh taken up at the Spring-head, in a clear crystal Phial, and shook by the Hand, while the Orifice is stopped with the Finger; they not only froth, when the Finger is taken away; but the included Air also, and the Water contiguous to the Neck, spirits and flies out with an audible Noise. The reason whereof has been already sufficiently explained; as being owing to nothing else but the agitation and motion of the very elastic or ætherial Principle we are speaking of.

20. And thus, by an induction of particular Experiments and Observations, we think it plainly

*Efficacy of
the Spirit
of Waters.*

plainly appears, that the brisk medicinal Waters contain a certain very subtle, active and elastic Principle ; to which the several Phenomena and Effects above related, are entirely owing. . And this Principle we take for their most curious and effectual part ; or as it were the Soul, that gives them their surprizing Virtues of curing numerous stubborn and obstinate Distempers. This noble, native Spirit it is, which, by its penetrating Nature and admirable Faculty, renders itself perceptible to the Sense ; not only affording a grateful Odour in its Exhalation, but also filling the Head, so as sometimes to render it heavy to such as receive the vapour of the Spring ; and making these who drink the Water sleepy. The same spirituous Principle is also of such an elastic, expansive and volatile nature, as to insinuate into the finest branches of the Arteries in the Head ; and so far to rarify the Blood, as to make it sometimes even oppress the Brain, and retard the Circulation : whence it is found by experience, particularly of the Pyrmont Waters, which are the strongest or most spirituous of all in *Germany*, that they cannot, in a hot and dry Season, be directly drank at the Spring-head ; but require, for that purpose, to be carried to some distance, for the Patients to drink at their Lodgings. For thus, by the time and motion of the Journey, the subtle Spirit, that would otherwise oppress the Head, gradually exhales, and goes off into the Air.

21. This Mineral Spirit is likewise the reason that the Waters endowed with it, do not cool and weaken the Body ; but rather heat and strengthen it : so as in some short time after drinking, to increase the appetite, raise and quicken the Pulse, and give a rosy Colour to the Face. The same subtle Spirit is also the Principle

ciple of their extraordinary Power and Efficacy; whilst it nimbly passes thro' the whole Body, and by its Subtilty, Agility, and Expansion, strongly endeavours to reach and stretch to the extremities of the Vessels; adding strength in its course to the moving Fibres, exciting them to motion, opening the Obstructions in its way, and throwing off what is noxious and superfluous, by all the Out-lets; as by Stool, Urine, Sweat, and sometimes by Vomit, according to the present disposition of the Body, or nature of the Distemper. And lastly, this noble Principle it is, which when exhausted or deficient, proves the decay and destruction of Mineral Waters; whence some Springs of late date, being greatly frequented at their first Discovery, as productive of surprising Effects, and curing Diseases that had been found incurable by other means, have soon after lost their reputation; and for want of this presiding generous Spirit, sunk to the condition of common Water, and worked no more such wonders. Thus we have Instances of a few Springs, which, at their first discovery, have perfectly cured the *Gutta Serena*, Deafness, Lameness, the dead Palsy, Falling-Sickness, &c. which extraordinary Virtue has not been lasting; but in a small compass of time dwindled and expired. So that the Springs in such high repute, afterwards became perfectly useless, in those very Distempers they had before so happily cured*.

22. As an experimental Illustration of this Account, we will here subjoin a set of Observations and Experiments made upon the Pymont Waters; which, more than any others we have tried, abound in this fine, elastic, mineral Principle.

And

* In order to supply this natural Decay of Springs, see the Attempts for making Mineral Waters by Art. S E C T. VII.

The Pyrmont Water examin'd.

And, (1.) the hydrostatical Instrument we commonly use for determining the specific Gravities of Fluids, being plunged into a parcel of this Water, newly taken from the Spring-head, stood at six Lines; whereas in common Water it stands at four. (2.) With powdered Galls this Water turns almost of an inky Blackness. (3.) Upon dropping in Spirit of Vitriol, there arose a violent Conflict. (4.) Upon the addition of Syrup of Violets, there appeared a green Tincture. (5.) To the Taste, this Water was pungent, sharp, and somewhat vitriolic. (6.) Upon shaking the containing Vessel, the Water affords an innumerable parcel of Bubbles. (7.) Being drank in a sufficient quantity, it purges a little, passes off presently by Urine, and restores a lost Appetite. But if this Pyrmont Water be poured into a large Bason, and suffered to stand for twenty-four hours, exposed to the temperate and open heat of the Air, the following Phænomena ensue.

(1.) The specific Gravity alters, and the hydrostatical Instrument sinks to four Lines; which manifestly shews, these Waters have now the same specific Gravity with common Water. (2.) They no longer turn in the least black with Galls. Nor (3.) make any conflict with Spirit of Vitriol. (4.) They no longer turn Syrup of Violets green. (5.) They have now lost all their particular Taste, Odour and Pungency. (6.) If drank, they now oppress the Stomach, fill and distend the Intestines with wind, and pass off slowly. (7.) Their pleasing Transparency is lost, and the Water becomes thick and muddy, with a skin of various Colours on the surface; and a chalky, and irony Sediment at the bottom. So sudden is the Catastrophe of these strong medicinal Waters; which thus, from being possessed of excellent Virtues, change to a flat, dead, useless Water,

Water, of no medicinal Virtue; barely for want of the spirituous Substance, wherewith it was before so plentifully endowed: as manifestly appears, not only to Reason, but also to the Senses.

23. After having said thus much of this fine mineral Spirit, Mens curiosity will doubtless be raised to ask the particular nature of the thing, whereof we relate such wonderful Virtues and Effects. To satisfy them all we can, we must come to a chemical Consideration of the Subject; and with the generality so well instructed in that Art, as to understand our meaning: for we have not the least intention to amuse Mankind, or in any respect force a false Notion upon them. Just Facts and Experiments are what they must be guided by; and if our Notions and Theory are not built upon these, we desire they may not stand. Our Opinion therefore is, that this extremely moveable, subtile, and elastic Principle, is a portion of the universal Spirit, the Fountain and Cause of all the particular Spirits in other things, whether of the vegetable, animal, or mineral Kingdom. But as this Spirit seems to have a principal seat, and chiefly to exercise its Power in what we, in a chemical sense, term Sulphur, or a pure oily and inflammable Matter; and as this Sulphur is of three kinds, according to the three Kingdoms, animal, vegetable, and mineral; this universal Spirit coming to be differently modified, altered or changed, according to the different Sulphur wherein 'tis lodged, thus assumes a different Nature, and becomes productive of different Effects. By mineral Spirit, we therefore understand an exceedingly rarified, fluid, elastic and volatile Substance, blended in amongst, and combined with all the sulphureous Parts of Minerals; and pervading all the lower Regions

*Origin of
the Spirit
in Waters.*

Regions of the Earth; so as to become the animating Principle of Minerals, and the true Cause and Origin of the various Changes and Effects which happen in the Bowels of the Earth: whence it is often found amongst mineral Bodies, under the form of a penetrating sulphureous Vapour; and becomes the certain Sign and Evidence of Mines, or an Earth productive of Metals. And this Spirit coming in the way of Waters, as they flow along the entrails of the terrestrial Globe, is caught up by them in their passage, and thus impregnates them with their medicinal Virtue*.

24. Thus, at least, the Matter appears to ourselves: tho' we are not singular in this Opinion; but have the concurrent Testimony of some very eminent Men, who have made the search of Nature their Study. The Author we chiefly rely upon, in this Particular, is that great chemical Philosopher, *Becher*; who judges the Mineral Waters do not proceed from hence, that certain concreted Juices of the Earth are dissolved by the Water running over them; because, if that were the Case, the subterraneous Parts abounding therewith, tho' almost ever so large, and well furnished with the mineral Matter, would, by the continual flux of these Waters be, at length, washed away; but rather, to speak in his own chemical Language, that "They consist of a
"central

* This Doctrine will receive greater Evidence and Confirmation in the course of the Work; and seems farther countenanced by the Experiments and Observations of Dr. *Lifter*, Mr. *Boyle*, and other eminent Naturalists and Chemists. Particularly, certain Air-Pump Experiments, and the artificial Generation of Mineral Waters, by means of the universal sulphureous acid, and alkaline Earth, appear to strengthen it *à posteriori*. See SECT. VII. But the philosophical Doctrine of Mineral Waters is not the present subject; any farther than it relates to a Discovery of the Natures, Virtues and Uses of these Waters.

“ central Acid of the Earth, which is perma-
 “ nent, inexhaustible and mixed with but an ex-
 “ tremely small Proportion of a mineral Substance;
 “ for certainly the Virtue and Efficacy of such
 “ Waters are, in no wise, owing to their gross
 “ mineral Contents; but rather to their prodigi-
 “ ously elastic, volatile and spirituous Prin-
 “ ciple.”

25. The delicate Nature of this Spirit is the true and principal Cause of the great difficulty in preparing artificial Waters, that shall perfectly resemble, and have the noble Virtues of the natural hot, or cold medicinal Springs. For if the Cause were otherwise, and their Virtues owing to a Solution of any solid or saline Mineral Substance, it would be easy to collect the Matter that remains after evaporating the native Waters, and dissolve either that, or something of the same kind, in common Water; so as to imitate them in their Virtues. The only reason of failure in this Particular seems owing to a want of knowing how to introduce this curious subtile spirit †.

*Whether
 mineral
 Springs
 are imita-
 ble by Art.*

26. And

* See *Becher, Physic. Subterr. SECT. II. Cap. 4.*

† That Bodies may be regenerated, or recomposed, appears from several instances, particularly Nitre, common Salt, and Brimstone, from their acid Spirits; Quick-silver from Cinnabar; Iron and Copper from Vitriol, &c. Could not therefore a way be found, after the chemical Analysis of a Mineral Water, to combine its several Principles together again, in their natural Order and Arrangement; as it is no difficult matter to do, after such a chemical Analysis of Wine, by introducing a Fret; or at most a Fermentation: which entirely restores the natural, vinous Texture, as many Persons have experienced? It seems no unnatural Supposition, that all Mineral Waters, especially those abounding with a copious Spirit, are in a kind of fermentative state; which always gives a briskness; and ceases when the Spirit flies off: and that this Spirit, or something like it, may be introduced by Art, will appear when we come to consider the chemical ways of imitating Mineral Waters.

26. And the present Consideration suggests a Question of considerable moment; viz. Whether this most efficacious Principle of Mineral Waters cannot by Art, or some chemical Contrivance, be separated, obtain'd pure, and concentrated, or reduced to an admirable Medicine? For my own part, I conceive it a thing of great difficulty; yet have no room to question, that if a considerable quantity of such a spirituous Water were taken from the Spring, and immediately put into a large distilling Vessel, the Junctures whereof were exactly closed, and a very gentle Heat directly applied, a Spirit of great medicinal Virtues, might be procured: which is an Experiment that we earnestly recommend to the Trial and Diligence of the Skillful and Curious in Chemistry.

II. Of

ters. Attempts of this kind have been much discouraged by the general Opinion, that the Fire so alters the Texture and Arrangement of the parts of the Bodies, that they can by no means be re-inflated. But there are many instances to the contrary, in Solids, and some in Fluids; especially where the Analysis was gentle, and conducted by the Rules of Art. A proper Intermedium seems the only thing wanted; which for re-inflating Wines is any rightly disposed fermentable Matter; and for brisk medicinal Waters, perhaps a proper Alkali and Acid, in the requisite Proportion.

* By many exact Experiments, hitherto unsuccessfully made with this view, it appears that not the least quantity of such a mineral Spirit can be obtain'd, or rendered sensible and permanent. Whence it should seem that such a Spirit is not a corporeal thing, but rather an action or effect, depending upon a temporary conflict of the natural Acid and Alkali contained in the Waters; as was intimated in the Note above; and will be made more probable in the seventh Section, upon the artificial Imitation of the natural and medicinal Springs. However, the unsuccessful Experiments mentioned by the *Sieur du Clos*, as made before the Royal Academy of Sciences at *Paris*, are not sufficient to discourage any farther Attempts for procuring this Spirit: for, thro' the whole course of those Experiments, there appears a great want of the chemical skill and accuracy, so requisite to a thorough Examination of this Subject.

II.
Of the AQUEOUS PART IN WATERS.

27. We proceed to the second Ingredient of *The Nature and Virtues of pure simple Water.* Mineral Waters; which, to distinguish it from the rest, we call pure or elementary Water. This, in its quantity, exceeds both the others; and is the common receptacle, as well of their spirituous as earthy and saline Principles. Yet, as near as this aqueous Part may approach to common Water, it is not destitute of considerable medicinal Virtues; for by its Moisture, Thinness, or Degree of Rarification, 'tis wonderfully serviceable both in preserving and restoring the Health of the Body. It washes all the Juices, dissolves thick and viscid Humours, drinks up all the morbidic Salts in its passage, and coming into the innermost Cells of the *Viscera*, there wears away Coagulations, or the obstructing Matter, and discharges it, along with the other drossy Parts, by the proper excretory Ducts. And as this, we are well assured, from Experiment and Observation, compared with the natural structure of the Body, is actually the Case; it will be a thing of very considerable use; attentively to consider the Nature, Properties and Virtues of pure simple Water; without any mixture of the fine elastic Spirit, or any saline or mineral Ingredient. For 'tis certain, that according to the difference of the Place and the Soil wherein Springs rise, they differ extremely from one another: so that one Spring shall be much wholesomer, and fitter for various Uses than another.

28. In the first place therefore, it is a common *Snow Water.* Observation, familiar in the Kitchen and the Laundry, that some Waters are hard, crude and rough; and others again soft, mild, smooth, or as it were milky: The former whereof are

D

properly

properly accounted bad, and the latter good. Among the crude and hard Waters, we reckon that which is obtain'd by the dissolving of Ice: and of this Water *Hippocrates* says justly *, "that the clear, light and sweet Part is dissolved and lost in Water which has been frozen, and only the turbid and ponderous part left behind: for, if a certain measured quantity be set to freeze in the open Air, and the Ice be the next day dissolved, in a warm place, and the Water be now measured again, it will be found to have lost a large Proportion." The same Author likewise assigns a very good Reason why Snow-Water is rather pernicious than advantageous to Vegetables and Animals; as Water by freezing has its Texture destroyed. For 'tis manifest, that the subtile Principle of the Water is thereby separated from the gross Part, and driven towards the Centre: whence, in the middle of all Ice, there appear large Bubbles, proceeding from the subtile, elastic Matter being driven inwards; where, by its rarifactive Motion, it increases the bulk of the Ice, and causes it to possess a greater space, than when in the form of Water; and thus occasions the bursting of such glass or earthen Vessels as it happens to be contained in. And this shews by what means the fine fluid elastic Principle is separated; and only the grosser and more ponderous part left behind: insomuch that Water being despoiled and corrupted by this Operation, must needs become unwholesome. But principally the Use of Snow-Water is found to produce Swellings in the Glands of the Throat; as frequently happens to those who inhabit the bottoms of Mountains, that are all the Year covered with Snow; but especially to the Women, who have generally large Tumours hanging at their Throat,

* *De Aëre, Aquis & Loc. §. 20.*

Throat. And this the People who live at the foot of the *Alps, Pyreneans, &c.* to their great misfortune, experience. Those Waters therefore must be carefully avoided, which, upon a general Thaw, flow down the sides of the Mountains into the Vallies; and thus often infect and corrupt the Springs and Rivers.

29. In the next place, those Waters prove hard, crude and unwholesome, which are found in metallic Mines; or descend from very high Rocks; because they lick up in their passage many rough, earthy, and astringent particles from the Fossils, Minerals, Chalk-stones, and the harder compacted Bodies they run over; and thus become impregnated therewith: whence few can bear to drink them. And their Use, to such as are not accustomed thereto, proves very pernicious. Thus 'tis observed by *Hippocrates**, that those Waters are to be rejected as unwholesome which flow from Rocks; for this renders them hard: and those again which run near to hot Springs, Beds of Iron-stone, Sulphur, Alum, &c. as none but crude, heating and unwholesome Waters, that pass not well by Urine, and bind up the Belly, are to be found in such Places. And we cannot but commend the justness of the Observation, with regard to the common Waters found near hot Springs: for such generally prove crude and unwholesome, unfit for brewing, or promoting the Secretions of the Body; which they rather obstruct or hinder. And the reason hereof seems chiefly owing to the chalky, rough, styptic Earth, with which the Soil about these Springs most commonly abounds.

30. Again, those Waters are crude, heavy, and sluggish, which spring up in chalky Ground†; as may appear from the Pipes or Canals thro' which they run: for they all along deposite an

The Waters of Mines.

Chalky and stony Waters.

D 2

earthy

* *De Aëre, Aquis, & Loc.* §. 13.

† *Ibid.* §. 17.

earthy, chalky matter, that lines the inside of their Conduits; and when boil'd over the Fire, strike a stony Crust to the sides of the Vessel. In short, the stony Waters of all kinds, and those running upon chalky Beds, are unwholesome, crude and hard; as the Matter of these Beds is easily imbibed by the Waters, and renders them gross and heavy: so that when drank they pass with difficulty thro' the fine Vessels of the Body; nor readily reach the Extremities of the Veins, without causing Obstructions.

Stagnant Waters.

31. Lastly, those Waters are unwholesome which collect themselves in stagnant Ponds, and marshy Grounds, or are received into Reservoirs, form'd on purpose to preserve the Rain that runs from the tops of Houses; as also those of Springs, arising in an open champaign Country, and having a muddy, unctuous, earthy, or bituminous bottom; for all these are gross, turbid, and somewhat fetid: and tho' frequently refreshed by new Rain, they lose their fine, thin and most useful Principle, by the Sun's beating continually upon them; whence they are apt to cause Obstructions in the finer Vessels, and give origin to chronical Distempers.

Rain Water.

32. On the other hand, those Waters must be allowed good and wholesome, which are light, sweet, soft, thin, and readily pass thro' all the excretory Vessels of the Body. And of this kind, in the first place, are certainly those raised by the Sun into the Atmosphere. The Cause of this is, with more chemical Knowledge than one could expect, delivered by *Hippocrates* in these Words; "Because the Sun raises that part which is thinnest and lightest; leaving behind what is saline, gross and heavy, in the Sea." For in reality, Rain-Water is Water distilled by the Sun; which not only raises from the Ocean, but likewise

wife from all Springs and Rivers, the lightest and thinnest parts of the Waters, makes them mount into the Atmosphere, attenuates, perfects and digests them with its Rays ; and indeed enriches them with the universal, ætherial, and sulphureous Salt, or rarified and exalted Nitre ; as appears from Experiment and Observation. So that, by this means, the chemic Sun seems to prepare a perfectly pure and wholesome Water, which will readily pass thro' all the finest Vessels of the Body, wash the capillary Meanders thereof, and promote its own discharge by the Law of Circulation. Whence this naturally distilled Water is better fitted than any other for the Nutrition of Vegetables, the brewing of Drinks, the infusing of Herbs, all family Uses ; and is of itself, without farther Preparation, one of the noblest, and, when properly used, perhaps the most universal Remedy in Nature : as we purpose to shew more fully hereafter *.

33. We are sensible of the Objections brought against this general Position as to the Purity and Perfection of Rain Water. 'Tis said that " this Water soon putrefies, corrupts and stinks ; " and must thence necessarily become unwholesome." But to consider the matter chemically and closely ; tho' the Fact here alledged were certain, yet it only demonstrates, that this Water abounds with sulphureous Particles ; which is also confirmed by numerous chemical and philosophical Experiments. But this Inconvenience, attending Rain-Water, may in great measure be prevented, by catching it, not after it has washed the tops of the Houses, and run thro' foul Pipes and Conduits ; but as it falls immediately from the Air, in an open place where no Houses stand. For thus, when it has stood a while to settle,

D 3

cleanse,

* See S E C T. VI.

cleanse and purge itself, as it will in a very few days ; it may be drawn fine from its bottom, and long preserved perfect, in pure Vessels of Earth or Glass. But if put into Vessels of Wood, especially such as are new, it thence extracts numerous, fermentable, sulphureous Parts ; and accordingly runs into what is commonly called Corruption. And the reason of this Difference is plain from chemical Experiments ; for, as by standing, the gross Sediment here falling to the bottom, like the Lees of Wine or Beer, contains subtile, fermentable, sulphureous Particles, which have the Power to begin or renew an intestine, fermentative or corruptive Motion ; so when these busy Particles are once separated, whether by standing, Filtration, or Distillation, the pure remaining Fluid must needs remain unaltered in its natural Texture and Constitution.

34. 'Tis also worth observing, that the Rains which fall about the vernal Equinox, and in the Month of *May*, when the East and South Winds blow, are of a much more subtile and spirituous Nature ; or refresh and nourish all the vegetable Kingdom better and quicker than those that fall in other Months, when the Wind stands at different Points of the Compass. The reason whereof seems owing to this, that in the coldest Countries, or such as are filled with dense Vapours, the Exhalations of the Earth and Waters cannot be so much ripened and refined, as in Countries where a warmer Sun raises them up, concocts and brings them to maturity.

*Spring-
Waters.*

35. The next Degree of Perfection we assign to those Waters where the Springs lie high, rise in clean, earthy Hills, and run upon a gravelly bottom or pure hard Clay ; provided they be sweet, that is, perfectly tasteless, limpid, transparent, cold in the Summer, warm in the Winter,

and receive the Rising Sun. For when Waters pass thro' such a kind of porous, spongy Earth, which is not dissolved thereby; they are thus percolated, filtred and purified, after the manner of that common Practice in *Italy, Sicily, Holland*, and other Countries; where they pass their thick and muddy Waters thro' a certain spongy Stone, cut and chizzel'd into a kind of Mortar; so as to become a large and proper Filter, for thoroughly purifying the Water, which it transmits perfectly bright, clear, and grateful; leaving the Filth and Slime behind.

35. There are certain œconomical Observations, and ways of proving the Goodness, Excellence, Thinness and Virtues of Waters. It is a thing known to every one, that those Waters are soft and light which readily take Soap, easily wash Linnen, and quickly boil Pease, Pulse, &c. soft and tender: and the Waters which will not do this are properly accounted rough, harsh and hard. But for these purposes there is nothing comparable to Rain-Water; which is admirably fitted for the washing of Linnen, and boiling of Pulse, Herbs, &c. to the greatest Perfection. So likewise those Waters are to be esteemed good and excellent, which best serve the purposes of brewing, or the making of Malt-Drinks; for 'tis certain that the Wholesomeness of Malt-Liquors has a great dependance upon the Goodness of the Waters: whence such Countries always brew the best, wholesomest and soundest Drinks, as are supplied with the best and purest Waters. In general, hard Water makes the best Beer for keeping; and soft Water the best for Flavour, but apt to turn sour. And a proof of Excellence in this case, is when the Drink neither oppresses the Stomach, nor binds up the Belly; but passes readily by Urine. On the other hand, in those Countries where the Waters are thick, gross and
To try the Goodness of Waters.

slimy, the Drinks are unwholesome, generate Wind in the Stomach and Bowels, pass sluggishly thro' the Canals of the Body; breed Stones and stony Matters in the *Viscera*, rot the Teeth, relax the Gums, &c. of all which there are but too many Instances in particular Countries. Another Sign of Goodness in Waters may be taken from their feeding and producing fine wholesome Fish; and their indisposition to freeze. For these Particulars prove a fineness of Parts, and a temperate and wholesome Nature in such Waters.

*River
Water.*

36. Those Waters, likewise, that remain long sound and uncorrupted, may be esteemed good; as this affords some Token of their being free from Impurities, and Parts that do not properly belong to them; but being rather simple, pure, and full of the spirituous Principle, which preserves them from Corruption. And hence 'tis found, that if River Water, as well as Rain-Water, be first freed from its Filth by standing, drawing off from its bottom, or filtering thro' a porous Stone, and then put into proper large earthen Vessels, and preserved in a cool Vault or Cellar; it keeps much better and longer than when committed to little Vessels, and set in a warm place. And thus the Water of the *Tiber*, which the common People drink thick and muddy as it runs, is clarified and preserved by the Nobility of *Rome*, in large earthen Vases, that stand in their Wine-Cellars: whence it remains perfect and uncorrupted for many Months; or even for Years.

*Chemical
Signs of
good Wa-
ter.*

37. Besides the several Signs of the Excellence of Waters, above deliver'd, there are abundance more, derivable from the Art of Chemistry: tho' these being not so well suited for general Use, we shall not enter into a Detail of them; but

but finish this Account with observing, that soft, subtile Waters, and particularly those of Rain, are constantly found the fittest for washing what we call the Calces of Metals, from their Salts : whilst hard Spring-Water is very unsuitable for this purpose. And what is still more obvious, and may be tried by every one, the making of Plaister of *Paris* from calcined Alabaster, does not succeed with Rain, or other thin soft Water ; but in order to bring the calcined Powder to a stony hardness, a rough Spring-Water is required. *

III.

OF THE SOLID PARTS IN WATERS.

38. Thus far we have examined, with all the clearness we could, two of the Principles of Mineral Waters ; viz. the spirituous and the aqueous : we next proceed to the third, which is their solid Part. And this we find to be of different kinds ; and greatly contributing to the medicinal Virtues of the Waters. For both Natural Philosophy in the general, and our own numerous Observations and Experiments in particular, clearly demonstrate and exhibit to the Eye, that Mineral Waters not only abound with Salts, but likewise with Earths of different kinds. In discovering these various kinds of solid Substances, Physicians and Naturalists have been greatly deficient ; and delivered us very little of use, upon so important a Subject. Nor indeed could any thing better be expected from them, whilst they have generally remained grossly ignorant in philosophical and chemical Experiments ;
whence

*The Salts
and Earths
in Waters.*

* See the Affair of pure common Water discussed under SECT. V. where Water is considered as an universal Remedy. See also SECT. IV. which shews the Origin of the several Waters of the Globe.

whence they have transcribed from one another the more loose, popular Opinions, or flying Rumours upon this Head; without diving into, and solidly examining Matters of Fact. We shall here therefore attempt to supply this general Defect; and deliver a set of true and certain Marks, Signs, or Characteristicks, of the precise Nature of whatever Salt, Mineral, or metalline Matter is actually contained in Mineral Waters.

*No real
Metals in
Waters.*

39. Before we proceed to the Business itself, we must here note, and reject that common imaginary Notion, as to the Existence of Gold, Silver, Lead, Tin, Antimony, &c. in these Waters. For 'tis certain, and abundantly confirmed by chemical Experiments, that no Metals are soluble, or can possibly enter the Composition of Waters, unless the Metal be first dissolved, or turned into Salt or Vitriol: but in fact, there is no such thing to be found in the Bowels of the Earth, as the Vitriol of Gold, Silver, Lead, Tin, Antimony, Arsenick; and consequently these Metals and Minerals can never possibly come into the Waters, nor consequently be exhibited to the Eye, as a part of their Contents.*

*No Nitre
in Water.*

40. Another Error of the same kind has arisen from the Inattention and Fondness of certain chemical Writers; who are swayed more by Notions

* What the generality of Authors upon Mineral Waters pretend of their containing Alum, Sulphur, Vitriol, and numerous other fictitious Matters, is by Dr. Lister shewn owing to the Pyrites, sulphureous Marcasites, or Vitriol-Stone, so plentifully lodged in the Earth, and dissolvable by the Waters in their Passage. An exact Enquiry into the Origin, Nature, and Properties, of these Stones, is therefore preparatory to a philosophical Account of Mineral Waters. See Dr. Lister on the Medicinal Springs of England; especially the ninth and twelfth Chapters of his first *Exercitatio*; where the Foundation of the thing is laid.

Notions and Theories, than by Facts and Experiments; and would thus persuade us that Mineral Waters are impregnated with a true, material, and inflammable Nitre. The Foundation of the Error lies here, that true Nitre is not, as they imagine it, a fossil, or mineral Salt; nor ever dug up in the Earth; but strictly and properly belongs to the vegetable Kingdom, and the whole Mass of the Atmosphere; whence it comes to be deposited and lodged in a fat alkaline Earth, as a proper Receptacle: infomuch that we are not satisfied, by any Experiments of our own, or others, that true Nitre is obtainable from, or can be shewn to exist in Mineral Waters; at least not so much as it does in the Air itself: from whence it may by several Artifices be extracted; as particularly by exposing Quicklime, Pot-ash, or any fixed, alkaline Salt, or Earth, to the Air, in a place well shaded and defended from the Sun and Rain. *

41. With no less Absurdity, some have pretended, that Sal-Ammoniac is contained in Mineral Waters; whereas 'tis well-known that this Salt is an artificial Production from a mixture of a volatile, urinous Salt, Soot, and the Acid of Sea-salt. And tho' the natural Existence of this Salt in Waters is argued for, from the Sal-Ammoniac

*No Sal-
Ammoniac
in Waters.*

* According to the Account of the *Sieur du Clos*, there are numerous cold Springs in *France* that contain what he calls a true Nitre; as particularly those of *Pougues, St. Miin, Pont-Gibault, &c.* But he must surely mean by true Nitre, either the Nitre of the Antients, or the calcarious Nitre of *Dr. Lister*. The Nitre of the Antients was a lixivious alkaline Salt; and somewhat like it is found in Mineral Waters. But the calcarious Nitre of *Dr. Lister* is unflammable; and no way truly nitrous. Or if any Spring shall appear to contain a real Nitre, that is, Salt-petre; let it be carefully examined if this be not accidental, and properly owing to a vegetable Cause: for Salt-petre has no natural Mine, as Minerals have.

Ammoniac of the Ancients, and the Salt thrown up by burning-Mountains, such as *Vesuvius*, &c. yet whoever diligently enquires into these Matters, will find the antient Sal-Ammoniac was produced from the Urine of Horses, Camels, and other Creatures, discharged upon the Earth, and separated from its more aqueous Part, which strained away thro' the Sand, and left a concreted Salt behind; and that the pretended Sal-Ammoniac of burning-Mountains is but a sulphureous, saline Substance, and not what we properly and strictly call by the name of Sal-Ammoniac; tho' 'tis true it contains a volatile Spirit. *

*Fixed Salt
in Mineral
Waters.*

42. A third Error has been pretty generally maintained, upon the apparent footing of Experiment and Observation; viz. that there is naturally no such thing as fixed Alkali in all the Region of Fossils, or the entire mineral Kingdom; and that this Alkali could only be obtained from Vegetables, by burning them to ashes. But the contrary is evident to a demonstration; and rendered obvious to the Senses: for there is no hot or cold medicinal Spring, of all the large number we have examined, that does not afford, by a chemical Process, a pure fixed Alkali, like Salt of Tartar. And this is the more remarkable, because we know of no Spring in *Europe*, even amongst those which upon account of their Briskness, Spirituosity, Pungency, or a kind of Tartness, have obtained the Name of *Acidule*, that contained any pure Acid at all, but every one of them a quantity of fixed Alkali: whence, agreeably to their own
Nature,

* The Pretensions that Sal-Ammoniac is contained in Mineral Waters, rest upon slight Foundations; and seem to proceed directly from Unskilfulness in Chemistry. See *Histoire. de l'Academ. An. 1713. p. 29, 30.*

Nature, they should rather have been called *Alkalinae*. * And so much for the more prevalent Errors as to the Principles, of a fixed and solid nature, attributed to Mineral Waters. We next proceed to examine what solid Matters they really contain.

43. We begin with Metals; among all the Tribe whereof, with regard to Utility and general Benefit, Iron stands in the first place: the Vein or Ore of this being the largest, and most extensive of all others. For all the red Clays in *England, Italy, Germany*, and elsewhere, are but a kind of Iron-Ore; which is otherwise so very abundant, that 'tis hard to find any Part of the Earth wherein some irony Particles are not contained. Again, of all the Metals there is none that dissolves more easily in all kinds of Acids, than Iron. And thus pure Water itself, on account of the ætherial Principle, and the universal Salt it lodges, will soon prey upon and dissolve this Metal. So that if a piece of red-hot Iron be quenched in common Water, it communicates some Particles of itself thereto; as appears by the astringent, strengthening Quality, and the rough styptic Taste of the Water that has been thus heated. And as 'tis a familiar Observation, that the Moisture of the Air, Rain, &c. corrodes Iron, turns it to rust, and impregnates it self therewith; there is no question but that all Waters which wash the Beds of Iron-Ore, or take their Course thro' red, clay Grounds, lick up, in their passage, Particles of an irony nature; and come impregnated with them to the Spring-head.

Irony Matter in Waters.

* The Existence of an actual fixed alkaline Salt in Mineral Waters, is now confirmed by many Experiments made in different Countries. See, for instance, *Histoir. de l'Academ. An. 1699, 1701, 1702, 1708, &c.* See also *Urban. Hierne Aſſa & Tentamina Chymica. Ed. Holmiæ. An. 1712. p. 72, 137, 138.*

head. And accordingly, the Waters of such Springs, all over *Europe*, are called by the name of chalybeate, steel or irony Waters.

*The Proofs
of irony
Matter in
Waters.*

44. The external Signs of these chalybeate Waters are derivable from the astringent, styptic Taste, which they, in some degree, impress upon the Tongue; and the yellow kind of Oker wherewith the Canals or Conduits they pass thro' are lined; as also the Basons or Reservoirs that contain them, and the Parts about the Spring-head, where they overflow or are spilt. For if this kind of Oker, or rubiginous Matter, be collected, washed, dried, and thoroughly roasted over a strong Fire; it not only appears of an irony nature, by readily answering to the Load-stone; but affords a no less certain chemical Mark of its being Iron, by subliming with Sal-Ammoniac, into Flowers, that afford a bright and perfect Tincture of Iron. Other concurring Marks of their chalybeate nature are likewise afforded by the purple Colour, or inky Blackness which they make with powdered Galls, the yellow Colour wherewith they stain an Egg put into the Spring, and the Iron-mould they cause on Linen: all which are certain Characteristicks of a fine irony Rust, or the real and material Existence of Iron in the Waters. *

*The Proof
of coppery
Matter in
Waters.*

45. There are some Mineral Waters likewise that afford manifest Indications of Copper; tho' not in its true metalline state, but as dissolved and formed into Vitriol. This is eminently confirmed by Experiments made on many Springs in *Hungary*, particularly those at *Newsohl*; wherein

* Those who are unacquainted with Experiments of this kind, and their Validity for proving the Truth of things, may take it for granted that the Trials here produced as Proofs, are, in general, simple, well-chosen, and conclusive.

wherein if Iron be suffered to lie, it comes out pure and perfect Copper *. But the Waters of this kind are of no proper, specific, internal medicinal Use, by reason of the corrosive and vomitive Virtue which Copper ever retains ; tho' they may still be serviceable in some particular Cases, by way of Lotion or external Application. And besides these two Metals, no other that we know of, can by any just Experiment, Observation or Effect, be discovered and rendered sensible, or the least Marks of them traced in Mineral Waters. And as the medicinal Virtue of Iron is extremely great, the Waters that contain it are to be accounted the most wholesome and efficacious : whence we cannot but observe the Wisdom and Goodness of the Creator, who has so largely supplied all Countries with them. So much for the metalline Contents of Mineral Waters : we now proceed to their saline Ingredients ; which their aqueous part very well fits them to dissolve.

46. A principal Ingredient of this kind is the Pyrites or Vitriol-Stone, which of all others most plentifully and universally abounds in the Bowels of the Earth ; there being scarce a Mineral but what it cleaves to. This Stone owes its Origin to the Acid of common Sulphur, which is the universal Acid, or saline Matter of all Minerals, but

*The Proof
of a fine
Vitriol in
Waters.*

* The reality of this Fact has been much disputed by several Philosophers of *England*, and in general by such as are no Favourers of the Doctrine of Transmutation. The Fact appears to be no more, than that the Iron is dissolved away by the Water, which being impregnated with the Vitriol of Copper, leaves that Metal behind in the room of the Iron dissolved away : thus at once performing both a Solution and a Precipitation ; which is no uncommon Effect in Chemistry. Those who desire further Information in this Point may consult *Agricola de Re Metallica*, and several other German Writers.

but principally of Iron. And to consider the thing closely, the acid Exhalation of Sulphur is continually breathing upwards from the lower parts of the Earth; mixes in among the Waters as they flow along their Channels; associates it self with the earthy and irony Particles dispersed therein; and thus forms itself into a kind of vitriolic Principle. This Principle manifests itself in Mineral Waters by striking a purple Colour with Galls, if the fine Vitriol be only in a small Quantity; or by affording a deep black, like that of Ink, if it be large: and this single Experiment may be safely depended upon for the purpose, without the Concurrence of any other.

47. We have before intimated that the vitriolic Principle in Mineral Waters is of two kinds, volatile and fixed; but in all the most celebrated mineral Springs, whether hot or cold, there is no fixed Vitriol to be found. Those however that are most impregnated with the fine volatile, vitriolic Principle, may deservedly be accounted the most efficacious. It is a sure sign of their containing this Principle, when the Waters, fresh taken up at the Spring-head, turn black with Galls; but strike no Tincture at all therewith, after having been heated at the Fire, or exposed to the open Air. Which affords us a capital instance of the strange Error of those who endeavour to discover and manifest the Principles or Ingredients of Mineral Waters by the sole Assistance of Exhalation, or Distillation; for in these Operations the volatile, mineral Part, wherein their principal Virtue consists, certainly flies off and escapes, along with their fine efficacious Spirit.

48. If any Vitriol remain behind, after the Evaporation of the Waters, it may properly be called

called fixed ; and has much less medicinal Virtue than the former. And indeed there are some chalybeate Springs which afford a very minute portion of this fixed Vitriol, obtainable by a particular artificial Treatment. And the Waters that afford it do not only turn inky with Galls, but even with Oak-Leaves, Pomegranate Bark, Extract of Tea, &c. and thus yield a somewhat durable Tincture. But for the particular ways of separating and precipitating the irony Principle from these Waters ; let a Dram of calcin'd Oyſter-shells be put into a Pint of the Water, and the Mixture be kept well ſtopt for ſeveral days ; ſhaking the Veſſel between whiles : by which means a fine yellow Oker will fall to the bottom. A ſtill better way is to put a new-laid Egg into the Water ; for thus a yellow Subſtance will collect it ſelf, like Dregs, or flying Clouds, from all the parts of the Water, and afterwards ſink together to the bottom. The ſame Effect will likewise be produced by expoſing to the open Air, Bottles half filled with the Water : for thus the ſpirituſous Principle coming to exhale ; a very light and fine yellow Powder will be precipitated. For as it is the noble ſpirituſous Principle which detains and locks in the fine irony Matter with the Water ; when that Principle comes to be ſeparated, the Water, which before ſupported the Iron, will no longer ſuſtain it. But to obtain this irony Matter in the cryſtalline Form of Vitriol is a more difficult and curious Operation *.

49.

* It may be of ſome conſequence to have a clear Conception of this vitriolic Principle. The queſtion is, whether any true and ſolid Vitriol of Iron be naturally contained in chalybeate Waters ; ſo as without addition to be ſeparable from them. The Author maintains the Negative, from Experience ; and has Dr. Liſter, Mr. Boyle, the Royal Academy

The Proofs
of common
Salt in
Waters.

49. It is likewise usual for medicinal Springs to participate of common Salt; which is obtainable from them by a bare Exhalation of their Moisture; when, if the solid Matter remaining at the bottom, be duly wash'd, clear'd from its drossy parts, and exposed to crySTALLIZE, it shoots into Grains of a cubical Figure; crackles in the Fire; turns *Aqua fortis* into *Aqua regia*, or renders it capable of dissolving Gold: all which are infallible Signs of common Salt. But a more easy and familiar Experiment, which proves the dry Matter to be common Salt, is to drop upon it a little Oil of Vitriol: for immediately upon this, a sharp pungent Spirit will arise, in Vapour, and strike the Nose, so as readily to manifest its nature to those acquainted with that Sensation before-hand. Another certain Indication may likewise be had of common Salt residing in Mineral Waters, by dropping a little of the Solution of Silver into a parcel thereof: for if there be any Sea-Salt contain'd therein, the Mixture will immediately grow milky; and let fall a white Powder to the bottom.

50.

Academy of Paris, and other experimental Philosophers on his side. But that a solid Vitriol may by Art, and Addition, be procured from all irony Matters, is a well-known Fact: and the secret way of preparing a solid Vitriol of Iron, here intimated by our Author, may perhaps depend upon calcining the Oker, or irony Matter of the Water, then dissolving it in an acid and aqueous Menstruum; which will thus, by Evaporation and CrySTALLIZATION, form into regular Shoots of green Vitriol. But no Solution can thus be made, unless the Oker, or imperfect irony Matter be first burnt or calcined. It is also an ingenious Expedient of Dr. Lister to procure regular Shoots or Crystals from the Moulton Waters; by rubbing the inside of the containing Vessel with a little Alum: which may possibly afford a hint for procuring a true, solid Vitriol from Steel Waters, if they contain any. See *de Fontib. Medicat. Angliæ. Ed. Lugd. Batav. An. 1686. p. 33.* But the whole Matter is hereafter farther cleared up, S E C T. III. 5, &c.

50. Medicinal Waters,* contain, as was above observed, a fix'd alkaline Salt; and some of them a considerable quantity thereof: so as to be obtained from them by Evaporation, or the proper chemical Treatment. The certain Signs of their containing it are these; viz. (1.) The Conflict and Effervescence they make upon dropping any Acid into them; but especially Spirit of Vitriol. (2.) If the Salt procured from them by Evaporation, be again dissolved, it changes Syrup of Violets from blue to green. (3.) The same Solution makes along with Spirit of Vitriol, that call'd by the Chemists *Tartarum Vitriolatum*. (4.) The same Solution turns a Solution of Mercury-sublimate to a yellow Colour. And (5.) if this Salt be mixed with Sal-Ammoniac, it sets free the volatile part thereof; so that an urinous Spirit strikes the Nose, in Vapour, and thus becomes manifest to the Sense*.

*The Proofs
of an alk-
aline Salt in
Waters.*

51. Besides those already mentioned, there are many medicinal Springs that contain a certain Salt, which has hitherto no proper Name assigned it; but remains in a manner unknown: being of a neutral Nature, betwixt Acid and Alkali; and of a moderate Temperature in its Virtues and Effects. It has commonly been improperly call'd by the name of Nitre: but 'tis neither inflammable, nor crystallizes into a pyramidal Figure, nor affords an *Aqua fortis* by Distillation. We may therefore rather call it a neutral Salt; as it conflicts neither with Alkalies nor Acids, nor impresses a Sensation of Coolness upon the Tongue. Many Springs abound considerably with it; insomuch that some of them have afforded a quarter of an Ounce from twelve Ounces of Water. There are numerous Springs of this kind in *Germany*, about *Paris*, and in several parts of *England*.

*A Nitrum
Murale in
Waters.*

* See above, p. 43. 44.

52. The first who took any notice of this neutral Salt was Dr. *Lifter**, who calls it a chalky or calcarious Nitre. His Words are these :
 “ To the Salts already mentioned must be added
 “ a fifth kind ; viz. a calcarious Nitre ; the
 “ Crystals whereof are slender and long, with
 “ four parallelogram and somewhat unequal Sides
 “ in the middle ; but the Point consisting of two
 “ plain triangular Sides †.” This Salt doubtless owes its Origin to the Combination of the universal or sulphureous Acid, and a chalky Earth ; which is of an alkaline nature : for the Waters being impregnated with this Acid, and running upon a chalky Bed, whereof there is great plenty in the Bowels of the Earth, they imbibe Particles of the Chalk in their passage ; and therewith form themselves into a bitterish Salt. This receives both Confirmation and Illustration by mixing the Acid of common Sulphur with any kind of Alkali ; which thus produces a particular neutral, bitter and deterfivè Salt. But it is extremely difficult, by any admixture or particular Signs, such as are before laid down, to discover the

* *De Fontib. Medicatis Angliæ*, Cap. I. p. 13.

† This calcarious Nitre, otherwise call'd *Nitrum Murale*, is thus more largely described by its Discoverer. “ Tho' this Salt be little known, 'tis certainly the most common of all Salts in *England* ; being the same as grows in, and may be generally extracted from the crude or calcin'd Mortar of old Walls. It shoots into long and slender Crystals, with four parallelogram and somewhat unequal Sides, in the middle ; but one Point consists of two plain triangular Sides, and the other of two flat Squares. Sometimes the Shoots have five Sides in the middle. By repeated Solution the Salt wholly concretes into this kind of Crystals ; tho' few of them are thus obtained compleat and perfect. When the Salt is thrown upon the Fire it melts, and rises in Blisters, without flaming, and hardens like the whitest Pumice ; exactly after the manner of Alum.” See *Lifter. de Fontib. Medicat. Angliæ*. p. 6, 7. Edit. Lugdun. Bataw. 1686.

the Existence of this Salt in Mineral Waters ; on account of its Neutrality : but then there is an easy Remedy at hand ; for it becomes manifest, and exhibits itself to the Eye, by the bare Exhalation of the Water to Dryness.

53. It is a common Opinion that many mineral Springs contain Alum ; and the Experiment produced for it is, that by dropping Oil of Tartar into the Water, it becomes milky, in the same manner as a Solution of Alum would do. But this Experiment is fallacious ; because all chalky and saline Waters lose their Transparency, and become white or milky, upon the admixture of any alkaline Liquor, or even a limpid Lime-Water. But a certain and infallible Proof of Alum in the Waters would be, if the white Powder, precipitated from them by the addition of Alkalies, swelled and rose into a hollow spongy Mass when thrown into the Fire, or laid upon a red-hot Plate of Iron. But tho' in all our Experiments we have discovered no Signs of Alum in any Mineral Water, yet we do not deny that Springs may abound therewith, in those places where Alum-Stone is found, and dug*. And indeed there are certain Instances of the Fact. But then such Springs should not be called medicinal, or be used as such internally : for they are not only disagreeable to the Taste, from their Roughness, Austerity and corrosive Nature, but also unwholesome and prejudicial to the Body.

54. The Case is much the same with regard to Sulphur. 'Tis the general Opinion of Physicians that all hot Springs contain Sulphur or Brimstone ; and thence some strangely derive the Cause of their Heat. But in fact there are very few hot Springs that contain any Sulphur at

*The Proofs
of Alum in
Waters.*

*The Proofs
of Sulphur
in Waters.*

E 3

* In all the Experiments upon Waters, made before the Royal Academy of Sciences at Paris, as related by the *Sieur du Clos*, there appeared no signs of Alum.

all; and excepting one or two, there are not the least Marks discoverable of it in the rest. There are also some Writers who, to defend their own Notions with a shew of Experiment, argue there must absolutely be Sulphur contained in all hot Well-Waters; otherwise, say they, how is it possible the white Linen Shirts of such as bathe in them, should be tinged of a saffron Colour? But this Stain is owing to a very different Cause, and no Proof of Sulphur, in the form of Sulphur; but of some irony Matter. For my own part, I have taken great pains, by Experiments of all kinds, to discover, if possible, the Existence of this pretended Sulphur; and all to no purpose, except in one or two Springs. Nay, I have, with the utmost exactness that I was master of, examined such Waters as run hot, and with an abominable stench, like that of putrefied Eggs, from the Spring, and such as have been firmly believed full charged with Sulphur, and particularly those near *Frankfort on the Main*; but could not discover the least grain of Sulphur therein. And to those who would satisfy themselves in this particular, we recommend as determining Experiments for the purpose, the two following; which, if there be a real and substantial, or corporeal Sulphur existing in the Waters, will certainly discover it. The first is to suspend burnish'd Silver in the Water, to try if it will come out, not of a yellow, but of a dusky black Colour. The second is to try, if after Evaporation to Dryness, there be any inflammable matter remaining behind that will burn blue; and when melted with Salt of Tartar, make what the Chemists call Liver of Sulphur. If it be pretended that these Waters, tho' they may not contain Sulphur in substance, yet are impregnated with fine sulphureous Parts, to which their Virtue is owing; tho' we do not absolutely

absolutely disallow thereof, yet to encourage their Industry in a Subject of this consequence, we require not their Notions and Conjectures, but their Experiments and Observations: for nothing less than this will come up to the Point *.

§5. It remains, in the last place, to be examin'd, whether Mineral Waters contain any true and solid earthy Parts. Such a kind of Mixture in Waters may, to those unacquainted with chemical Experiments and Observations, appear contrary to nature, as they call it; but tho' Water be no proper Solvent of Earth, yet there is no Water without its earthy Principle. And we make no question, but this is a Principle that not only renders Waters wholesome, but likewise gives them some other Virtues. For it is certain, that the Earths found in different Waters, differ as much as those found out of Waters. Thus the most common and frequent Earth of Waters is the calcarious or chalky †; which abounds copiously in hot and salt Springs: so that some of them afford, upon Exhalation, a hard, shining and concreted Substance, resembling

*The Proofs
of Earths
in Waters.*

E 4

* That there are hot Springs abounding with Sulphur appears by the Account which Dr. Brown gives of the Baths of *Austria* and *Hungary*. For he not only observed true Flowers of Sulphur raised from some of them, and sticking to the upper part of the Pipes, thro' which the Waters run; but also that the Waters in a few Minutes turn'd Silver black, and heighten'd the natural Colour of Gold. See *Philosoph. Transact.* N^o. 59. So likewise the *Harrigate* Sulphur-Spaw, contains actual Brimstone, floating in it like Feathers, and separable by bare straining; and the Matter so collected, I have by proper Trials found to be good Brimstone.

† The *Lapis Calcarius* is, by Dr. Lister, made a *Genus*, under which he ranks all the Stones or Earths capable of being burnt into Lime. Hence Chalk, white Marl, Flints, the Selenites, Gypsum, the Stalactites, &c. are but Species of *Lapis Calcarius*.

bling *Asbestus*, or a kind of Talc. The Waters that have a fat clay or marly Bottom, are of a better kind; as Earths of this Nature render the Waters sweet, soft, and wholesome. Lastly, those abounding in a Substance like Oker, are highly medicinal on that account: and tho' this Earth owes its Colour to Iron; yet it is not dissolved by an Acid, because of its clayey or marly Nature: and therefore communicates a strengthening and drying Virtue to the Waters; as appears by their Effects.

56. It is somewhat difficult to discover the Existence of these Earths in Water by any particular Signs or Mixtures; and they can scarce otherwise be rendered sensible, than by evaporation. A chalky Earth, however, may be known upon dropping Oil of Tartar, or a Solution of Lead, into the Water, and its producing a milky Colour: and if such Earth abounds plentifully therein, especially if it be the Water of a hot Spring, the Earth separates from it in the cold Air, strikes to the sides of the containing Vessels, and, in a short time, lines them with a Crust. After Exhalation, when the Bottom is reduced to Dryness, this Earth may likewise be discovered by the Effervescence it makes with Acids; and again, by the extreme sharpness it acquires upon a thorough Calcination. The Signs of an Oker, or irony Earth in Waters, may be taken from the Sediment remaining after Evaporation and CrySTALLIZATION of the Salt; or its appearing of a yellow Colour, and turning red in Calcination. But if any thing of a stony nature be contain'd in Waters, it best manifests it self by frequent washings in fresh Water; where all the more subtile parts are dissolved and thrown off; while the heavier and
merely

merely terrestrial Matter, settles to the bottom, and cannot easily be wash'd away *.

57. From the whole of this Examination, into the ways of discovering and manifesting to the Senses, the Principles of all the different kinds of Mineral Waters, we may draw this general Conclusion; that there are, in reality, but very few Principles of these Waters; whilst many have been attributed to them, by Men unacquainted with the proper ways of examining them, upon the only sure Foundation of chemical and philosophical Experiments. Inference.

S E C T. II.

The ways of examining particular Springs, in order to determine their medicinal Virtues and Uses.

I. **A**S it is certain that medicinal Springs, whether of the hot or cold kind, found in different Countries, differ considerably with regard to the Principles, or Ingredients, they contain; and again, in point of Purity; whence some become serviceable in one sort of Distempers, and others in another; some of them useful in this Constitution, and some in that; it becomes a matter of Importance to determine the precise Virtues and Efficacies of different Springs, by the means of sure Experiments. And to lead others Introduction.

* Dr. Lister found by Experiment, that many of the English Springs contain for their Salts no other than common Salt and the calcarious Nitre; and for their Earth no other than an Oker, or real irony Earth, and a calcarious Stone. See *De Fontib. Medicat. Angliæ Exercit.* 1. Cap. 4.

others into a regular and just Method of doing this, or of discovering such Springs as are of greatest efficacy for the Cure of Diseases in every Country, is the Design of the present Section. To render the whole Matter familiar and intelligible, we shall proceed in the instructive way of Example, rather than Precept; and lay down Sets of Experiments, that we have our selves made upon the Waters of certain Springs of the greatest Character and Reputation in Germany: whence, at the same time, we shall have an opportunity of confirming their medicinal Virtues by Experience, and Instances of Persons who have drank them with success; and of thus demonstrating, that their Virtues correspond to the Contents, which our Trials manifest in them *.

I.

The ways of examining COLD-SPRINGS.

The Pyrmont Waters examin'd.

2. We begin with the *Pyrmont Waters*; which on account of their penetrating Nature, and quick Operation, hold the principal place among Cold-Springs. 'Tis remarkable of these Waters above all others, that the glass or earthen Vessels fill'd with them at the Spring-head, and well stop'd down, easily burst to pieces, with considerable Violence, upon shaking or being gently heated: so that if Flasks thereof are to be carried to distant places, 'tis necessary not to fill them quite, or else to let them remain open for some hours, that their volatile, elastic Spirit may in some measure fly off.

3.
* The Reader will please to observe, that tho' the following Experiments and Observations were made upon the Waters of *Germany*; yet they answer the End for which they are here produced, as well as if they had been made upon the Waters of *England*; viz. that of shewing the particular Methods of discovering the Virtues and Uses of the Waters in all Countries, by the way of Example.

3. If these Waters be drank cold, upon an empty Stomach, in the morning, they not only briskly strike the Nose with a subtle penetrating Vapour that rises from them; but also render the Head giddy, as if the Person had drank too much Wine.

4. They sometimes operate by stool; and this the more powerfully when they are not drank at the Spring-head, but carried to some distance before they are used*. And the Matter they thus discharge out of the Body, is of a blacker Colour than happens upon drinking the Waters of other cold Springs. But they lose all their purgative Virtue by being long exposed to the open Air; and in that case do not tinge the Excrements black.

5. If Tea-Leaves, Balauſtian Flowers, or powdered Galls, be thrown into a Glass of this Water, it first acquires a blue Colour; which soon after turns to a purple, and at length a black. This shews that the black Colour proceeds from a Concentration of the purple; and that the blue Colour is nothing more than a faint or dilute purple. But if a little Spirit of Vitriol be dropt into the Water, that is thus tinged, all the Colour presently vanishes.

6. If any acid Spirit, whether of the stronger kind, such as Spirit of Vitriol and *Aqua fortis*; or of the weaker, such as Vinegar, Lemon-Juice, or *Rbenish* Wine, be mixed with this Water,

* Dr. *Stark* finding, upon Evaporation, no bitter cathartic Salt in these *Pyrmont* Waters, will not allow them properly purgative; but attributes this Effect to their being drank hastily, or in large quantities; in which case common Water would have the same Effect. See *Philosoph. Transact.* No 351. But from the Account here given, they appear to be somewhat purgative, by means of their volatile, vitriolic Spirit; which is also vomitive, when it abounds largely in Steel-Waters; as appears by an eminent Instance in the newly discovered strong, chalybeate Waters of *Passy* in France. See *Histoire de l'Academ. An. 1720. p. 46.*

Water, it causes a manifest Ebullition; and throws up a large quantity of Bubbles to the top, with Violence, and a vaporous Exhalation.

7. On the other hand, if any alkaline Liquor, whether of the fix'd sort, as Oil of Tartar, or of the volatile, as a dilute Spirit of Sal-Ammoniac, be mix'd with this Water, no observable Conflict or Ebullition ensues: but the Water only becomes a little thick and white. And if now Spirit of Vitriol be dropt into it, so as to saturate the alkaline Principle, the Water again becomes pellucid.

8. Upon mixing an equal Quantity of Cow's Milk along with this Water, the Milk does not curdle, but rather becomes more fluid; and is by this means preserved from turning sour: which affords an indisputable Proof that this Water abounds not with an Acid*.

9. If Syrup of Violets be mix'd with this Water, it turns of a deep green Colour; which presently disappears upon the addition of a few drops of Spirit of Vitriol.

10. Upon evaporating forty-eight Ounces of this Water over a gentle Fire, we obtained two Scruples of a dry Matter; one half whereof being put into a proper Glass, we let fall thereto thirty drops of Oil of Vitriol; upon which there arose a strong Ebullition, and a fine rarified Vapour, that sharply struck the Nose; in the same manner as when Oil of Vitriol is poured to common Salt. Upon the other half of this dry Matter we poured some pure Spirit of Vitriol, which made a Conflict therewith, and turned it into a bitterish saline Substance; leaving behind a considerable proportion of a chalky Earth, which

* This Particular is farther confirmed of these Waters by Dr. Stare; who found they did not curdle Milk even when boiled, in an equal quantity with it: but caused the Milk to continue several Days without turning sour. See *Philosoph. Transact.* N^o. 351.

which when washed in fair Water, no longer made any Effervescence with an acid Spirit.

11. Upon exposing several Pints of *Pyrmont*-Water, in a large silver Vessel, for twenty-four Hours, to the open Air, we found it so much alter'd from its original State and Disposition, as scarce to be distinguishable for what it was : so sluggish and unactive it appeared. For to the Taste it had quite lost its mineral, brisk and penetrating nature; and was become perfectly insipid. It was also changed in its Transparency, and become thick and turbid; with a fine yellowish Earth fallen to the bottom. And when the Liquor, that floated above this Powder, was poured off, it no longer made any Ebullition with an Acid; nor turned black with powder'd Galls; nor green with Syrup of Violets*.

12. From these several Particulars it plainly appears, that the *Pyrmont* Waters very copiously abound in a pure, penetrating, elastic mineral Spirit; whereon their principal, or distinguishing Virtue and Efficacy depend. For, this highly rarified Principle, so long as it cleaves to the earthy and chalky Particles of the Water, assumes the nature of an Alkali: but being also join'd with a subtile irony Earth, it resembles the nature of Vitriol; has a vitriolic Taste, renders the Excrements black, and makes an inky Tincture with Galls. Therefore, whilst this Principle remains in the Waters, it thus renders them extremely active and powerful in opening Obstructions, and promoting the Secretions of the Body.

The Doctrine of the preceding Experiments and Observations.

* Those who desire to see how these Observations and Experiments upon the *Pyrmont* Waters, made at the Spring-Head, agree with those made upon the same Waters when brought to *England*, may consult Dr. *Stare*'s Account of the *Pyrmont* Waters, given in the *Philosophical Transactions*, N^o. 351. Whence no very considerable difference will appear betwixt them.

Body. But when once this Spirit is gone from them, all their medicinal or distinguishing Virtue and Excellence is lost, or goes off along with it. And as these *Pymont* Waters copiously abound with this spirituous Principle, and consequently have a strong Operation and Effect; 'tis evident that the use of them is rather suited to such as are of robust and corpulent Habits, than Persons of a soft, delicate, and tender Constitution. Yet they may, with great safety and advantage, be drank by the weak and infirm, in a small quantity; or diluted with other pure and wholesome common Spring-Water. They are also very advantageously mixt with an equal quantity of Milk; and thus become eminently serviceable to Persons troubled with the Gout and Scurvy: of which we have seen numerous Instances, in our long Experience of these Waters *.

The Waters of Egra examined.

13. Next to the *Pymont* come the Waters of *Egra*, as nearly approaching them in Virtue: for altho' they do not abound so largely in Spirit, but are of a milder nature; yet for this reason they are drank with more success, and at present are more frequented than the *Pymont* Wells. An immense quantity thereof is also yearly sent to foreign Countries.

14. Upon pouring Spirit of Vitriol into this Water, there arises a manifest Ebullition; tho' not so large as in the *Pymont* Water.

15.

* Dr. *Slare* has taken some pains to root out the strong prejudice we commonly have to Milk in a Course of the Steel Waters. He expressly declares, "that he has frequently advised Milk to be given daily in the Evening thro' a whole Course of the Steel Waters, with good effect;" and affirms, "that some could not bear those Waters, unless mixed with a third or more of Milk." The Doctor adds, "nor do I find the least reason to prohibit the use of Milk in a Course of Bath Waters." See *Philosoph. Transact.* N^o.

15. Upon mixing Oil of Tartar with this Water, it still remains transparent or limpid; without any thickness or foulness: whereas other Mineral Waters generally turn muddy, or milky, upon dropping an alkaline Liquor into them; on account of the common Salt, or chalky Earth they contain.

16. If this Water be fresh taken from the Spring-head, it turns purple with Galls; but alters not its Colour therewith, when carried to any great distance; unless the containing Vessel were very exactly closed: which is a sure indication that it contains extremely little, if any thing, of an irony Earth.

17. With Syrup of Violets it turns of a dilute green: which shews that an alkaline Principle a little predominates in it.

18. A Solution of the Vitriol of Iron being added to it, throws down yellowish Clouds, or a dreggy Matter to the bottom: tho' this is rather owing to the Vitriol it self, that was added, than to the Water; which thus dissolves and diffuses the Vitriol, whilst the Acid thereof meets with the alkaline Salt of the Water, and lets go its fine Particles of Iron.

19. Upon distilling twelve Ounces of this Water, in *Balneo Mariae*, we obtain'd a perfectly insipid Phlegm; and twenty-four Grains of a dry saline Matter. Upon this Matter we poured Oil of Vitriol; but there ensued no struggle or effervescence, nor any volatile fume: which shews this Water contains no common Salt.

20. Hence it is manifest, that the Waters of *Egra* owe their purging quality to their large quantity of bitter cathartic Salt; which is of a neutral nature, in respect to Acid and Alkali: and this purging Salt is yearly prepared from these

The Doctrines of the Experiments.

these Waters, by boiling; and sent away, in very large quantities, to other Countries. The Salt has no Virtue different from that commonly called *Epsom* Salt: and if an Ounce of it be dissolved in a Pint of Water, it purges advantageously; or gives three or four Motions, without disturbance. These Waters are also highly commendable on account of the Subtily, Lightness and Purity of their aqueous Part: and may in this respect be preferred to the *Pymont* Waters; which abound with a copious Oker and a chalky Earth. 'Tis therefore agreeable to Reason and Experience, that the Waters of *Egra* are well fitted for carrying off Viscidities, especially in the first Passages; and washing away the matter that causes Obstructions in hypochondriacal Persons, or those of an ill Habit of Body; discharging such Matter by Stool; and again, for opening Obstructions in the Blood-Vessels of the *Viscera*, or dissolving any tough, fizy Humours lodged therein *.

*The Seltz
Waters
examin'd.*

21. We next proceed to the *Seltz* or *Selters* Waters, which for their Excellence are celebrated far and near; and on account of the mild manner they act in, are drank with singular advantage, even by extremely weak, emaciated and consumptive Persons, and those of weak or unsound Lungs.

22. These Waters make an immediate Effervescence with any Acid, whether it be strong or weak; and if mixt with *Rhenish* Wine, and a little powdered Sugar, they bubble up in a violent manner, with a crackling Noise, and Fume; whilst the whole mixture appears like the Froth of Milk.

23.

* Our common purging Waters of *Aston*, *Epsom* and *Northall*, nearly answer the same Intentions as these Waters of *Egra*, and are in most respects as good; whilst, with respect to the Mineral Spirit, and a light Chalybeate tendency, the Waters of *Scarborough* and *Cheltenham* seem to equal them.

23. When mixed with an equal quantity of old Hock, they turn dusky, or appear of a brown reddish Colour; in the same manner as when Oil of Tartar, or strong Spirit of Sal-Ammoniac, is poured into a generous white Wine.

24. The Taste of these Waters is not sprightly, penetrating and tartish, like the Waters of other brisk Mineral Springs; but somewhat lixivious upon the Tongue.

25. They turn not blue, or purple, much less black, with Galls; nor tinge the Excrements inky, in a Course of drinking them.

26. With Oil of Tartar they turn milky; but let fall no Sediment to the bottom.

27. Twenty-four Ounces of this Water being gently exhale'd away, left behind a Dram and twelve Grains of a saline Matter; which being again dissolved in Water, and pass'd thro' filtering-Paper, afforded a Lixivium, from whence we obtain'd two Scruples of a pure alkaline Salt. To a Solution of this Salt we put a Solution of Mercury-Sublimate; whence a fine yellow Precipitate, or Turbith Mineral, gradually fell to the bottom. We had also the pleasure of seeing an Infusion of Rhubarb turn'd to a beautiful red Colour by this Solution.

28. This same alkaline Salt being mix'd with Sal-Ammoniac, bound up the Acid thereof, and set free the volatile, urinous Part; so that it rose in Spirit, and briskly struck the Nose: which are all evident Signs of a fix'd Alkali.

29. Having saturated twenty-four Ounces of this Water with Spirit of Vitriol, then gently exhale'd away the Mixture to dryness, we procur'd a Dram and a half of a neutral Salt, like to the *Tartarum Vitriolatum*.

30. We know of no medicinal Waters which so easily run into Putrefaction and Stench as

these ; infomuch that the Bottle must be perfectly filled, exactly stop'd down with a Cork, and carefully pitched over, to preserve them found.

31. If this Water be expos'd to the open Air, in a wide Vessel, for twenty-four Hours, it entirely loses its original Taste, and becomes lixivious ; as if Oil of Tartar had been dropt into it: and yet there falls no yellow Substance to the bottom.

The Doctrine of the preceding Experiments and Observations.

32. An attentive Consideration of these Phenomena will clearly shew, that this Spring plentifully abounds with the Matter of a pure alkaline Salt ; of which it contains a larger quantity than any other in Germany. Yet it holds no bitter calcarious Salt, nor any Principle of Iron: whence it has no great purgative or astringent Quality ; but principally operates by Urine. Again, this Spring is but sparingly supplied with the fine volatile Mineral Spirit ; and for this Reason proves of a very mild and gentle Nature. All which being considered, it follows that these Waters are not only innocent, but may frequently be used with great advantage, even by such as are of the weakest Habit of Body ; and particularly in scorbutic, phthysical and nervous Disorders. They may either be used alone, or, what is still better, mixed with Ass's or, Goat's Milk : which Method of drinking them I first, with good Success, introduced above five and twenty years since ; and numerous Physicians, with the same Success, have followed my Example. I think I can assuredly affirm, that for diluting and washing off acid and ill-concocted Humours, correcting the bad Habit of the Blood and Juices in arthritical or gouty Persons, and for relaxing and restoring the contracted nervous Parts, there is not a safer,

safer, a surer, more immediate and effectual remedy, than the *Seltz Waters* drank with Milk. *

33. We come next to the most noted Spring in all *Germany*; the Waters whereof are extremely pleasant to the Taste, and commonly called by the Name of the *Tonnstein Waters*. *The Tonnstein or Antonian Waters examined.*

34. These Waters have this in common with all other brisk and cold Springs, that they cause an Ebullition with Acids: and on this account, when mix'd with Sugar and tart Wines, froth up, like Milk; with a great Smoke and hissing Noise: thus discharging numberless Bubbles, as it were in a thick Mist or Steam.

35. They afford no Tincture with Galls; but preserve their natural Clearness when mixed therewith: which shews they contain no irony or vitriolic Particles.

36. They turn Syrup of Violets of a faint green, like all other sprightly, cold Springs: which shew they abound with an alkaline Principle.

37. If Oil of Tartar be dropt into them, they presently turn milky; and let fall a light Sediment: which shews they contain common Salt, or somewhat of a chalky Nature.

38. By standing, any considerable time, in an open Vessel, exposed to the Air, they also lose their pungent Taste and Transparency.

F 2

39.

* The *Selter's Water* is now pretty commonly sold at *London*; and being of a peculiar Nature, deserves to have its Virtues and Uses more generally known. There is no Water of the same kind hitherto found in *England*; nor even a tolerable Substitute for it. 'Tis a Water suited to all hectic and feverish Complaints; agreeing very well with the Stomach; and not cooling too violently. It appears remarkably serviceable in most inflammatory Cases, the hot Scurvy, and in all tendencies to a Consumption from inflamed or feeble Lungs; and seems to abate the Heat occasion'd by Matter breeding, or bred in any Part of the Body.

39. When evaporated in a Pewter Bason, set over the Fire, there appears a Skin upon their Surface, exhibiting various Colours ; which is a Phænomenon that does not appear in other Waters of this Class.

40. Twenty-four Ounces of these Waters being evaporated to Dryness, there remained two Scruples of a solid Matter ; which being again dissolved in fair Water, and properly treated, yielded one Scruple of Salt, and another of chalky Earth. The Salt was put into a Glass, and a few Drops of Oil of Vitriol poured thereon ; which presently caused a great Ebullition, that sent out a thick pungent Vapour, exactly of the same kind as arises from a mixture of common Salt and Oil of Vitriol.

The Doctrine of the Experiments.

41. Hence it plainly appears, that the *Tonnstein* Waters contain little alkaline Salt, but a large Proportion of common Salt, chalky Earth, and mineral Spirit ; whence they prove of a mild and gentle Nature, so as not to act powerfully either by Stool, or Urine. They may therefore, with safety and advantage, be used, both in chronical and acute Distempers, either alone, or mixed with Wine ; so as to serve instead of Malt-Liquors, which are seldom proper in Distempers. They seem also capable of being still farther applied with Success, in the Cure of hypochondriacal Diseases. *

The Wildung Waters examined.

42. The *Wildung* Waters have a great Affinity with those of *Tonnstein* ; and are commonly

* A Water of this kind was a few Years ago sold common in *London*, under the Name of *Bourne* Water ; but of late is scarce to be met with. It came over in blue and white stone Bottles with narrow Necks, containing about three Pints. It was the greater Curiosity here, as we have not one remarkably spirituous, or brisk-tasting Water hitherto found in *England* ; nor any that are tending this way, without partaking of Iron.

monly used rather in the way of Diet than Medicine.

43. They afford manifest Signs of an alkaline Principle ; as making a Conflict and small Effervescence with Acids. They also appear plainly impregnated with a fine Mineral Spirit ; because, if long exposed to the Air, they lose their peculiar mineral Taste.

44. They afford no Tincture with Galls, or Balauſtian Flowers ; and turn but lightly green with Syrup of Violets.

45. Twenty-four Ounces of this Water, upon Exhalation, affords four Grains of alkaline Salt, and eight of an extremely white Earth, soluble in Spirit of Vitriol.

46. From these Experiments it appears that the *Wildung* Waters are of a milder Nature than any hitherto examined ; and therefore highly proper to be used, either alone or with Wine, instead of the ordinary Drinks. And altho' they are not well fitted for overcoming obstinate, chronical Disorders, or cleansing the first Passages ; yet they may be employed to good advantage, for tempering and diluting the sharp Juices in Gouty and Scorbutic Cases.

The Doctrine of the Experiments.

47. The *Swalbach* Waters, kept in Bottles but lightly stoppt, grow fetid, and deposite a yellow Sediment.

The Swalbach Waters examined.

48. If fresh taken up, and mix'd with Galls, they turn purple ; and drank at the Spring-head, tinge the Excrements somewhat blackish : which shews them inclining to an irony Nature.

49. They make an Effervescence with Acids ; turn thick and milky with Oil of Tartar ; and if exposed to the open Air, entirely lose their grateful Taste and laxative Virtue.

50. Twenty-four Ounces of this Water being exhaled, left almost two Scruples of a saline

Matter ; a third part whereof was a kind of Oker.

The Doctrine of the Experiments.

51. Hence it appears, that the *Swalbach* Waters are of a middle Nature, betwixt those of *Egra* and *Pyrmont* ; and may, by reason of their fine mineral Spirit, and subtile irony Principle, not only promote the natural Excretions of Stool or Urine ; but at the same time strengthen the Offices of the Parts : and consequently are of great Use in hypochondriacal Cases.

The Spaw Waters examined.

52. Tho' I have myself had no Opportunity of examining the Waters of the *Spaw*, yet I cannot omit giving some Account thereof from the more eminent Writers upon them ; but especially from *Henricus ab Heer*, who has wrote an elegant Treatise upon the Subject, entitled, *Spadacrene* ; and partly also from the *physical Essays* of *Vallerius*.

53. If the *Spaw* Water be carried to any great distance from the Spring, in well-stopt Bottles, it lets fall, after some considerable time, a small Quantity of Matter, like yellow Oker.

54. A single Grain of powder'd Galls will presently tinge an Ounce of this Water of a deep purple : but if the Water be first heated, it changes not its Colour with Galls.

55. These Waters do not curdle Milk ; and when mix'd with Wine, throw up a hot Steam, almost like boiling Water, that smells very gratefully, and exhibits an agreeable Sight of sparkling Bubbles to the Eye.

56. This Water seems to intoxicate ; but that Effect is commonly over in a Quarter of an Hour.

57. The *Spaw* Water is specifically lighter than common distilled Water, by one Grain in about an Ounce and a half.

58. Twelve Ounces of this Water yield, by Evaporation, a Grain and a half of a white Powder.

59. Supposing these Experiments just, it will appear from them, that the *Spaw* Waters are perhaps as light and subtile as any of the cold Springs; their specific Gravity being less than that of the common distilled Water. And as they contain but a small Proportion of Earth, or saline Matter, and a large one of the universal Mineral Spirit, 'tis easy to conclude they must have great medicinal Virtues; which are fully related by *Henricus ab Heer*: who principally recommends the drinking of them in Diseases of the Bladder and Kidney, the *Gonorrhœa*, and venereal Ulcers of the Mouth and Tongue. But beside these Virtues, which seem peculiar to the *Spaw* Waters, they have others in common with the cold medicinal Springs. *

The Doctrine of the Experiments.

60. The *Buch* Waters make a strong Effervescence with Oil of Vitriol; and turn Syrup of Violets of a deep green; but give no Tincture with Galls.

The Buch Waters examined.

61. Upon dropping a Solution of the Vitriol of Iron into them, some light curdly Matter gradually falls to the bottom.

62. Twenty-four Ounces of this Water affords, by Evaporation, twenty-two Grains of a saline, alkaline Matter; which being again dissolved, gives sixteen Grains of pure alkaline Salt, and six of Earth.

63. Upon pouring Oil of Vitriol to this Salt, there arose a violent Ebullition; but no Vapour at all, like what common Salt would have afforded.

F 4

64.

* For farther Confirmation and Illustration of these Experiments and Observations, see Dr. *Stare's* Account of the *Spaw* Water, examin'd in England. *Philosoph. Transact.* N^o. 337.

64. These Waters, tho' drank in a large quantity, do not purge, yet operate powerfully by Urine; but if a proper quantity of Spirit of Vitriol be added to them, it produces a Salt that immediately gives them a different Taste and a purgative Virtue.

65. They are impregnated with a copious Mineral Spirit; which flying off, leaves them in a manner insipid.

66. Hence it appears, that the *Buch Waters* excel others in Purity, Lightness and Subtily; being impregnated with a saline Alkali, and a copious elementary Spirit. But because of their adjacency to the *Egra Waters*, and the hot *Caroline Springs*, they are almost neglected by the Inhabitants: and the Physicians who practise there, seldom prescribe them, except while the Course of Bathing is in hand at the *Caroline Springs*. But 'tis somewhat strange that these *Buch Waters*, which, in Medicinal Virtue, do not fall short of the *Seltz* and *Tonnstein*, should not be exported to other Countries; especially as they keep excellently, when the Bottles are well stoppt down.*

II.

THE WAYS OF EXAMINING HOT SPRINGS.

The Caroline Springs examined.

67. Having thus shewn the way of examining the Virtues of Waters, by particular Examples, in several of the capital cold Springs, we proceed to the hot ones; and shall begin with the *Caroline Springs*, which, on account of their Reputation, require the first place.

68.

* The *Seltz Waters* may very well supply the want of these.

68. That these Waters contain a large quantity of alkaline Matter, appears from the Effervescence they make upon mixing with any Acid; and their taking off the Sharpness of the strongest Oil of Vitriol.

69. The same thing also appears from hence, that twenty-four Ounces of this Water, being gently evaporated, afford a Dram of a dry alkaline Powder, which readily makes a conflict with any Acid, turns Syrup of Violets green; affords a yellow Precipitate with the Solution of Mercury-Sublimate, and turns an Infusion of Rhubarb to a beautiful red.

70. A Dram of this alkaline Powder being dissolved again, and evaporated to dryness, affords half a Dram of alkaline Salt; and eighteen Grains of Earth: the remaining Part of the Weight being lost in the Experiment.

71. 'Tis remarkable of this Salt, that if it be prepared in a large quantity, and long exposed to the open Air, it becomes of a neutral Nature; by imbibing the universal, sulphureous, acid Spirit from the Atmosphere. And hence, if it be afterwards melted in a Crucible, along with a third part of powdered Charcoal, it turns to a Mass like the *Hepar Sulphuris*; from which, when dissolved, a pure Brimstone may be precipitated or regenerated.

72. That these Waters also contain a larger Quantity of Earth, partly of a chalky, and partly of an irony Nature, than any other Spring in Germany, appears not only from the milky Colour they acquire by the addition of Oil of Tartar, and a Solution of Sugar of Lead, or Silver, which turns them milky, and throws a Sediment to the bottom; but also from the vast Collections of a very hard Stone, somewhat resembling Jasper or Marble, which line the Sides
of

of the Spring, and chuff over the contiguous Planks : tho' this Stone appears somewhat softer, and more brittle on the Insides of the wooden Pipes, thro' which the Water passes ; as also on the Sides of the bathing-places.

73. From hence also proceeds the white Skin on the Surface of these Waters, when they have stood for four and twenty hours in the Bath. This white and very subtile Cream of the Water, not only serves to cleanse and whiten the Teeth, dry up and skin over Ulcers, as well as the stony Crust lodged in the Pipes ; but also makes a Conflict, and, in some measure, dissolves with Acids : tho' one half of it thus remains undissolved ; as being more gross and terrestrial than the other.

74. These Waters have this almost peculiar to them, that tho' drank as hot as possible, they prove strongly purgative ; so as to occasion ten or more Motions downwards : whereas other Fluids taken too hot, prove astringent, and rather act by Sweat. Yet this purgative Virtue neither palls the Stomach, nor diminishes the Strength. 'Tis also remarkable, that upon the internal Use of these Waters, for some days, the Feet generally swell : but this Inconvenience is presently removed, by three or four times bathing. It must be observed, that the drinking of them, either cold or hot, is not without some danger ; as being very apt to stagnate in the Body, and pass with great difficulty, both by stool and otherwise. Those also, who bathe in the Water, whilst it remains considerably hot, generally thence acquire the Head-Ach, Palpitations of the Heart, and fall into intermittent or even continued Fevers ; especially if they have not drank the hot Waters first.

75. From a due Consideration of these Experiments and Observations, the Effects of this Water seems owing to the large quantity of chalky Earth it abounds with. For its purgative Virtue seems to proceed from its alkaline, earthy, and chalky Matter, dissolved by the Sharpness of the Juices, and acid Remains of the Aliment in the first Passages; so as to degenerate into a neutral Salt, that exerts a purging Quality, like that prepared with the white Manganese *, and Spirit of Vitriol: on which Principle the common *Epsom* Salt is, by Experiment, plainly proved to act. And if this Earth be not well diluted and dissolved, in the first Passages; but the Waters come loaded and clogged therewith to the Mass of Blood; they must necessarily circulate with great difficulty, thro' the fine Canals and capillary Vessels, especially those of the Head; or even stagnate in these Vessels, and produce mischievous Effects. On account, therefore, of this Crudity and Grossness of these Waters, it becomes necessary, not only in the Course of drinking them, but more particularly when the Course is over, to take some purgative Medicine, that may prevent the fatal Obstructions they might otherwise occasion in the Intestines and Habit of the Body.

76. And as these Waters pass with Difficulty thro' the fine Canals, they must, of consequence, stagnate in the weaker and relaxed Parts; especially

* The *Magnesia alba*, or white Manganese, is that chalky, alkaline Matter, obtained by evaporating, and calcining the Remains of the Mother-Liquor, left upon the refining of Salt-petre, and that will not shoot into Salt. This white Manganese is but little known, and very little used in *England*; tho' an agreeable and gently purgative Medicine; particularly good in costive Habits of Body, and in hypochondriacal Disorders. It is likewise much given abroad, in order to promote the passing, or to quicken the Effects of Waters, so as to render them more deterfive and purgative.

cially where the *Viscera* are touched or unbound ; and hence becoming extravasated, increase their Disorders. It were therefore better for all phthical, hydropical, and paralytical Persons to abstain entirely from the internal Use of these Waters ; or at least to use them with the utmost caution. But all that is here said, regards only the common, violent Spring, called by the Natives the *Prudel*.

77. The mild Spring without the Town, which runs gentle, near the Mill, and thence called the Mill-Spring, is of a less dangerous nature ; and tho' of excellent Use, was formerly quite neglected. But coming to examine it almost thirty Years ago, and discovering its Excellence from the Principles it contained ; I advised the Use of it to several of my Patients, and persuaded some Physicians to do the like ; whence, by degrees, I brought it more and more into request. And tho' the common Physicians at first oppos'd it violently, according to their Custom ; yet now it has for several years been used, both externally and internally, by none but Persons of the first Rank ; and that with extraordinary Success. For, altho' the Phænomena these Waters afford, upon mixing with various Liquors, almost exactly correspond with those of the other common, violently hot Spring above-mentioned ; yet the present warm one is preferable on this account, that it proves more purgative than the other ; and neither occasions the Sleepiness, nor Swelling and Distension of the Body, which that constantly does. Besides, Persons of the most tender and delicate Constitutions, those of weak Nerves, those subject to spasmodic Disorders, and Tremblings of the Limbs, as also those afflicted with large Bleedings at the Nose, or otherwise, may both drink this warm Water, and bathe in it, without

without any Danger of such violent Symptoms as attend the external and internal Use of the scalding hot Spring. And if we closely examine into the Reasons of this Difference, it appears to be, that the Mill-Spring holds extremely little of that chalky Earth, wherewith the other is strangely clogged; and therefore proves much more subtile and light than that. For the Mill-Spring does not deposite any stony or thick crusty Matter on the sides of the Pipes, thro' which it passes, nor in its Receptacles. And if twenty-four Ounces of this Water be exhaled, it leaves a Dram of a dry Matter; which, by the proper Process, affords two Scruples and three Grains of an extremely pure Salt; and but five Grains of an earthy Substance: whereas twenty Ounces of the Water of the other Spring yields but half a Dram of Salt; and full seventeen Grains of Earth. Lastly, the Water of the Mill-Spring, besides an alkaline Salt, affords one that is bitter and neutral, exactly resembling that called *Epsom* Salt. And this may be easily got from it, and rendered visible by dissolving twelve Ounces of the alkaline Salt, in twice its quantity of Water, and setting it, in a wide glass Vessel, to exhale upon a Sand-Heat; for, thus the neutral Salt, as being the heavier, will fix to the Bottom and Sides of the Glass; whilst the alkaline, lixivious Salt still remains dissolved in the Water.

78. The famous hot Springs of *Aix la Chapelle* The Aken have a great affinity with the *Caroline*; like which ^{hot Wells,} they are violently hot, and throw up, and strike ^{or Waters} to the Sides of their Conduits, a vast quantity ^{of Aix la} of stony Matter. The Cream they afford is also ^{examined} inspid, like that of the *Caroline* Waters; and floats upon their Surface, whilst they remain warm: and if this Cream be thrown into the Fire, it neither crackles nor melts; but remains
I
fixt.

fixt. These Waters have not only the same purgative Virtue with the *Caroline*, which is not so common in other hot Springs; but also the Experiments made with both, and the Phenomena thence resulting, differ but little. Thus they both make a conflict with Acids; turn milky, and let fall a Precipitate with Alkalies; shew no Blackness with Galls; and upon Exhalation leave an alkaline, or in some degree, a neutral Salt, behind them. Twelve Ounces of the *Aix* Waters afford twenty-five Grains of Salt; and five Grains of Earth. But herein they differ; that the *Aix* Waters have the peculiar property of changing Silver to a dark Colour, which is a manifest Sign of their holding somewhat sulphureous, or of the same Nature with common Brimstone; and indeed, at the Spring-head of the *Cæsarean* Bath, there may sometimes be collected several Pounds of true Flower of Brimstone, sublimed by the Heat, and sticking to the Arch and Top of the Well-room*.

79. On account therefore of the Sulphur, the alkaline, and the neutral Salt which they plentifully contain, these hot Springs have some particular and extraordinary Virtues, in palliating and curing some external Disorders. For whilst they powerfully dispel the morbidic Humours deeply fixt upon the tendinous and nervous Parts, they soon disperse and cure all Tumefaction, Pain, Trembling, Numbness, and paralytical Disorders of the Limbs; and at the same time, by their strengthening and contracting Virtue, support and confirm the Parts, that were too much relaxed; so as to take away all Inability and Indisposition to Motion. They also mollify the hard Ligaments in gouty Cases, cure Contractions, and
all

* Upon examining this Matter, it proves in all respects to be real Brimstone, no way differing from the common; tho' it is sold, as a Curiosity, at an extraordinary price.

all cuticular Diseases ; or restore the Skin when any way eaten or corroded by sharp Humours lodging under it. These Waters are likewise proper in spasmodic Disorders of the Nerves and Membranes ; and therefore of service to Persons of hard, swollen or distended *Viscera*. Lastly, these hot Waters are of eminent service in female Disorders ; so as to prevent Miscarriages, promote Pregnancy, cure the white Flux, and effectually open Obstructions in the uterine Vessels, and forward the menstrual Discharges.

80. The *Embsene* Waters plentifully abound with alkaline Salt ; insomuch, that twenty-four Ounces thereof contain a Dram of that Salt ; which readily makes an Ebullition with Spirit of Vitriol, and thus concretes into *Tartarum Vitriolatum*: which, when again dissolved in Water, and exposed to the cold Air, coagulates into a solid Mass. These Waters also throw up a large quantity of Bubbles ; and make a gentle Effervescence upon being mixed with any Acid. They turn thick and milky with Oil of Tartar ; green with Syrup of Violets ; and dusky with Galls. Hence it appears that these hot Waters have a great degree of Subtily, and Purity, contain few earthy Particles, and consequently are fit for Persons of tender Constitutions ; as being well-adapted to pass the finer Vessels of the *Viscera*, dissolve the gross Humours that may be lodged therein, and carry them off by the urinary Conduits ; yet so as to strengthen and support the weakened Parts. Whence they prove serviceable in Contractions of the Limbs, Relaxations, and spasmodic Disorders.

81. The *Wishad* Springs were famous in the times of *Tacitus*. The Water makes a small Effervescence with acid Liquors ; turns thick and white with Oil of Tartar ; and upon the Exhalation

*The Emb-
sene hot
Springs ex-
amined.*

*The Wis-
bad hot
Wells ex-
amined.*

tion of twenty four Ounces, leaves half a Drain of dry Matter behind: which seems to approach the Nature of common Salt; both by its crackling in the Fire, making an Ebullition, and raising a white pungent Vapour with Oil of Vitriol. From whence we infer, that these hot Springs, besides an alkaline Principle, contain also some Proportion of common Salt; to which their purgative Virtue is owing. They also contain a subtile Oker; which they throw up plentifully, so as to line the Sides and Confines of the Spring, with a thick yellow Crust. From all which there is no room to question but these *Wissbad* Waters have a great medicinal Virtue, and might advantageously be used in many Distempers. And tho' formerly they were only employed externally; yet now for these last twenty or thirty Years, they have been found eminently serviceable in many Cases, when used internally *.

III.

The Ways of examining such SPRINGS as have a particular Nature and particular Principles.

82. We have hitherto examined such Medicinal Springs as come under the general Names of *Acidulae*, and *Thermae*, or brisk and hot; but in reality owe their operative Virtue in part to an alkaline Principle. We next proceed to examine such as fall not under either of these Denominations, but

* Several of the above-mentioned *German* Springs have been likewise examined by that eminent Chemist *Urbanus Hierne*, chief Physician, and Metallic Counsellor to the King of *Sweden*. This Author bestowed six Summers upon the Enquiry; and his Experiments appear to agree with, and confirm those here delivered. Vide *Urban. Hierne Adu. & Tentamina Chemica in Regio Laboratorio Stockholmiensi*, Edit. *Holmiae*, An 1712. p. 71, 72, &c.

but are of their own peculiar Nature; and abound with very different Principles. And among these we shall give the first place to such as receive their Virtue from an iron Substance; whence they have been anciently called *Steel Waters*.

83. Among Steel Waters we reckon the Waters of *Radeberg*, *Lalichstad*, *Bebran*, *Freyenwald* and *Weiffenburg*; all which, if carefully examined, are found to contain no other visible effective Matter, besides a very fine *Crocus* of Iron, commodiously received and harboured in an exceeding light and elementary Water. For they do not manifest, or so readily lose their fine spirituous Part, as the others above mentioned; nor participate of an alkaline Principle, as neither making an Effervescence with Acids, nor turning Syrup of Violets green. They also differ from most other medicinal Waters in this, that they turn of a black purple with Galls; and when long exposed to the open Air, or when boiled, they let fall a yellow Sediment. Nay, the Matter they separate, manifestly exhibits to the Eye their peculiar Nature, and the iron Principle they abound with: for not only the Confines of the Spring are sometimes coated over with a yellow Oker; but the Insides of the Pipes are lined with the same kind of Crust: and a like Substance they deposite after standing some Weeks. This okery Matter proves, upon Examination, to be no other than Iron reduced to a subtile Flower, or a natural *Crocus Martis*, like the artificial; as appears from hence, that it may not only, by Calcination, be converted into a true *Crocus*; but also, if mixed with an equal quantity of Sal-ammoniac, and put into an ignited Crucible, there sublime from it bright Flowers; which, being collected and

Of Steel Waters:

thrown into Spirit of Wine, afford an excellent Tincture of Iron.

84. To examine the medicinal Virtue of these Steel Waters; we shall find them endued both with an operative and strengthening Property; so as to be advantageously used as well internally as externally. Thus, when drank they loosen the Belly, but strengthen the Body and Stomach, and provoke the Appetite; and may therefore be very safely and serviceably used in such Distempers as give way to any Preparations of Iron. Their external Use, in the way of Bath, is very considerable, for strengthening and cherishing benumbed and motionless Limbs; curing Pains, Contractions, or Relaxations; and for drying and healing up old Ulcers. And tho' used for this Purpose, in the way of Bath, made but gently warm; yet they heat the Body, open the Pores of the Skin, and provoke Sweat; especially if the Patient goes directly from the Bath to bed.*

*Of bitter
purging
Waters.*

85. There are other medicinal Springs which can neither be reckoned among the *Acidulae*, *Thermæ*, nor Steel Waters; but are of their own peculiar Nature; and contain a pure, neutral, bitter, purging Salt. These kind of Springs are very rare in Germany†; and none of them known to this Day, besides those which I some Years since discovered at *Sedlitz* in *Bohemia*; and after having carefully examined their Principles, taught their Use, and introduced them with good Success.

*The Sed-
litz Water
examined.*

86. Before I came to examine this noble Water, it had never been of any domestic Use: only there

* There are numerous Springs of this kind in England; and perhaps no County without several of them.

† But very common in England; for those of *Epsom*, *Dulwich*, *Northall*, *Atten*, &c. appear of this kind.

there run a Rumour among the Inhabitants, that half a Pint of it would purge. There was this remarkable observed of it, that tho' in the Winter, and in rainy Weather, the Spring flowed much freer than in the heat of Summer, yet it always retain'd the same Taste; and, as I afterwards found, the same Virtues, and Quantity of Salt. For an Instruction to others, who may happen to be less versed in the Examination of unexperienced Springs, I shall here deliver my whole Procedure on this Occasion.

(1.) I first poured a quantity of the Water into a clean, crystal Glass, where it appeared perfectly limpid; but to the Taste proved remarkably bitter and saline. (2.) I then let fall into it a few Drops of the stronger Acids; such as the Spirit of Vitriol, Spirit of Nitre, &c. but perceived no Signs of any Ebullition: and as it turned not green with Syrup of Violets, I was hence well assured it abounded with no alkaline Principle. (3.) It did not turn purple upon mixing with Galls; which shewed it contained no irony Substance. (4.) Upon mixing with Oil of Tartar it grew somewhat thick; as generally happens when any chalky Earth is harboured in Water. (5.) Upon a slow Evaporation of twelve Ounces thereof, I obtained two Drams of a bitter neutral Salt, like that in *England* called *Epsom Salt*.

87. Upon the Strength of these Experiments, I recommended these Waters to the Physicians near the Place; to be used instead of the rough and coarse Purgatives of the Shops; and intreated them to go upon a fuller Discovery of its Virtues: but scarce any one of them thought me worth their Attention; till a very favourable Opportunity happened to establish the Reputation of these Wells. For, in the Spring of the Year

1721, when the Empress came to the *Caroline Waters*, she made use of those in *Sedlitz*, in the Presence, and by the Advice of her chief Physician, whom I had acquainted with my Discovery; and before whom I afterwards repeated my Experiments: upon which we, with Caution, gave of the Waters to Persons labouring under intermitting Fevers, and to great advantage. This excellent Physician afterwards returning to *Prague*, along with the Empress, recommended this Water to the Nobility of *Bohemia*; upon which an immense quantity of it was sent both to *Prague* and *Vienna*; where it was fully approved for purging advantageously, and strengthening the Stomach. And in the Autumn following, the Nobility and Gentry of *Bohemia*, who yearly flock to the hot Wells at *Toplitz*, drank these purging Waters with great Success. And now the Fame of them reached to *Dresden*, *Berlin*, and others of the most considerable Cities; where at present they use the *Sedlitz Waters* as common as those of *Egra*.

*The Salt
of the Sed-
litz Wa-
ters.*

88. But as the principal Virtue of these Waters resides in their Salt; and as the Carriage of them to distant Places is troublesome and expensive; I persuaded a Chemist of *Toplitz* gently to evaporate the Water, so as to obtain its pure Salt for publick Sale: and the Event proved answerable to our Expectation; for he now yearly disposes of very large Quantities thereof; and sends it to distant Countries.

89. The Character of these Waters being thus established, I went upon examining more narrowly into the Nature of the Soil adjacent to the Spring; and the Search was attended with this Advantage, that we discovered another Spring near *Seydschutz*, not far distant from *Sedlitz*; but it lies somewhat higher; flows in plenty;

plenty; and has a bitter and more saline Taste. And it seems, upon the whole, unquestionable, that this Spring runs down to, and supplies the Waters of *Sedlitz*. The Principles however of this Spring, and the Nature of its Salt, differ not from those of the other; for upon Examination they both exhibit the same Phænomena; tho' the latest discovered affords the largest quantity of Salt; twelve Ounces of this Water yielding two Drams and ten Grains of Salt, and fix of a chalky Earth. The Reason seems owing to this; that the Spring which lies higher is less exposed to the Reception of the Rain-Water, than that of *Sedlitz*; which lying lower may be easily weakened by the Rain, or the Admixture of other Water.

90. As this Salt has a great Relation to that called *Epsom Salt*, we will here deliver the Experiments we made on both; the better to manifest the peculiar Nature of each. The learned Dr. Grew was the first who, from the Waters of *Epsom*, prepared such a kind of bitter, purging Salt; and wrote an elegant Treatise on the Subject.* But as twelve Ounces of the *Epsom* Water will not afford above half a Dram of Salt, 'tis certain that the Salt which commonly goes by the name of *Epsom Salt*, and is sent into foreign Parts, in large Casks, and sold for less than Six-pence the Pound, cannot be prepared from those Waters; but is rather an artificial thing. And in fact 'tis not only prepared in *England* from the Bittern, or bitter Liquor that remains after the making of common Salt; but also at *Leipsick*, and other Parts of *Germany*, in very large quantities. And it appears plainly,

*The Sedlitz
and Epsom
Waters
compared.*

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that

* This Treatise was originally published in *Latin*; but translated into *English* by Dr. Bridges, and printed, with Notes, at *London*, in 1697.

that a certain aluminous Acid, mixt along with the alkaline Earth of common Salt; is contained in the Bittern which affords it. But it's remarkable, that all Salt-Springs do not yield this neutral purgative Salt; perhaps only because the Salt-Waters do not run upon Beds of Alum-stone.

91. (1.) The *Sedlitz* Salt is of an opaque, snow-white, or milky Colour; but the *Epsom* Salt more transparent and watery: whence its greater specific Gravity, and disposition to relent in the Air. (2.) The *Sedlitz* Salt, whether in a solid Form, or dissolved in Water, tastes much bitterer, and more nauseous than the *Epsom*. (3.) Both of them, when thrown into an ignited Crucible, melt and lose one half of their Weight in a watery Vapour; but the *Sedlitz* Salt flows clear and thin like Water; whilst that of *Epsom* is more viscous and tenacious. (4.) Neither of them in the least dissolves with the highest rectified Spirit of Wine. (5.) Both of them melt, along with Pot-ash and powdered Charcoal, into a Mass like the *Hepar Sulphuris*: But the Mass thus made by the *Epsom* Salt, turns with Water of a much deeper green Colour than the other; and when the Solution is precipitated with an Acid, affords a much larger quantity of *Lac Sulphuris*. (6.) Both of them, when mix'd with Vitriol, calcin'd to Redness, and put into an ignited Crucible, yield a Vapour like that of

Dr. *Hoy* was the first who discovered the way of preparing this *Sal Catharticum Amarum* from Bittern; but now the Secret is grown common; tho' the best way of purifying and perfecting the Salt, seems not yet known. For the common way of making it, see the *Philosophical Transactions*, N^o. 378 and 379. For purifying and imitating it with Alum and Salt of Tartar, see *Histoire de l'Academie*. An. 1718. p. 38, 39. But for improving upon it, let Trial be made with the white Manganese, and pure Spirit of Vitriol.

of Spirit of Salt : and this Vapour is soon followed by that of the volatile Spirit of Vitriol. (7.) The *Sedlitz* Salt turns Syrup of Violets green ; but the *Epsom* Salt alters not the blue Colour of the Syrup. (8.) A Solution of either coagulates with Oil of Tartar ; so that scarce any thing falls out when the Glass is inverted : but the *Sedlitz* Salt coagulates strongest. (9.) In like manner, a clear Solution of either becomes very turbid upon the addition of Spirit of Sal Ammoniac ; and affords a large quantity of curdly Matter. (10.) An Ounce of Water will dissolve an Ounce and two Scruples of *Sedlitz* Salt ; but only an Ounce of the *Epsom*. (11.) A rich Solution of the *Sedlitz* Salt appears of a yellow Colour ; whilst that of the *Epsom* Salt remains limpid, without discolouring the Water. (12.) The Crystals they both afford by Solution, and Evaporation, scarce differ at all ; except that those of the *Epsom* Salt are larger and more beautiful, in some sort resembling Nitre. (13.) The *Epsom* Salt, being kept for some Days upon a Sand-heat, loses its Transparency ; and becomes in appearance like that of *Sedlitz* : from all which 'tis manifest that these two Salts have a great affinity, as well in their Principles as their Nature and Virtue.

92. The Experience of such as have drank these *Sedlitz* Waters, confirms them serviceable for washing off all crude, viscid, acid, bilious and corrupted Humours, lodged in the Stomach and Intestines ; and this in so safe, easy, and agreeable a manner by Stool, that nothing seems better disposed, or more effectual for the purpose. Other medicinal Waters, tho' they may move the Belly, yet require to be drank in large quantities before they will operate ; and therefore easily pall the Stomach : whereas the seperate quick,

and in a small Dose; so that three or four Tea-Cups full generally prove sufficient; and the strongest Constitutions scarce require more than a Pint. There is also this Property attending these Waters, that they require not to be used for any long time; but only for eight or ten days at most; and that too intermediately. And as they exceed other purging Waters in the Quickness and Efficacy of their Operation, so their Wholesomeness and purgative Virtue recommend them before all other purging Medicines in use; scarce one whereof but operating more or less than was intended, weakens the Patient, gives him a Sickness at the Stomach, and lessens his Appetite; whereas the *Sedlitz Waters*, tho' they purge briskly, have none of these ill Effects; nor occasion dryness of the Mouth; but rather by their bitterness relieve the Stomach, and provoke the Appetite. We can therefore assuredly affirm, that there is not in any Dispensatory, nor in all the Catalogue of Drugs, a Purgative that operates with such safety, efficacy, agreeableness, quickness and certainty as these Waters. In hypochondriacal Disorders, I never found any thing so serviceable; and have known several who, after remaining highly costive for many Years together, were perfectly relieved by the Use of this Water. These Waters are also found eminently serviceable in ill Habits of the Body, Obstructions of the menstrual Discharges, in scorbutic Cases, in the Piles, Worms in the Body; and in short, for curing and preventing many other Distempers, if drank with the necessary Caution.

*The Sedlitz
Water
how to be
imitated.*

93. As these extraordinary Virtues of the Waters seem principally owing to their Salt; it is proper to enquire whether the Salt could not be obtained from them, so as to produce the same good

good Effects. 'Tis certain that a Salt may be thus procured, which being dissolved in Water, shall have some Resemblance with the Mineral Spring; but whether any Art can make the Imitation perfect, and in all respects equally serviceable with the natural Water, may be questioned. For 'tis evident, upon Experience, that there is a great difference betwixt such Mineral Waters as are taken up at the Spring-head, and such as are artificially prepared by dissolving the Contents, gained by Evaporation, in the purest Spring-Water: for the artificial do not pale so readily, nor so effectually raise a languid Appetite, nor increase the Strength, nor purge so well as the natural. And this evidently appears in the present Waters, which being drank at the Spring-head, have a bitterer Taste than if the same quantity of Salt they afford, were dissolved even in a less proportion of fresh Water; and six Drams of the Salt will scarce purge as often as a Pint and a half of the Water, which contains but three Drams of Salt. Whence these natural Mineral Waters, besides the fixed saline Particles, intimately mixed therewith, are likewise impregnated with a subtile, tho' insipid aerial Principle, that by its Fineness and Elasticity, forces its way thro' the slender Cavities of the Canals; and, as it were, opens the Passages for the Water to follow it; in such a manner, as greatly to increase its Operation: and this is not only to be understood of purging Waters, but of other Mineral Springs. For a free Access of the Air, and the Effect of Fire, strangely alters, impairs, and destroys the Connexion, Arrangement, and Mixture of the Parts, which give medicinal Waters their specific Virtue and Efficacy.

94. If therefore Attempts of this kind should fail, we might try to produce some other Salt, wherewith to impregnate common Water, in imitation of the purging Waters. Thus Glauber's artificial Salt* has some resemblance with the Epsom Salt; and proves, when the point of Saturation is exactly hit, a Salt of a neutral Nature; of a bitter Taste, and a purgative Virtue. But its Taste is much more pungent than either the Epsom or Seidlitz Salt; tho' it contains a larger quantity of Water: insomuch that if laid upon a warm Sand-Furnace, it melts and runs like Water, and loses one third of its Weight. Again, if dissolved in an equal quantity of Water, and exposed to the Air, it coagulates into a solid Mass. On the other hand, if Oil of Tartar be added to the Solution, it does not coagulate, as the Seidlitz and Epsom Salts do. However, there are several other neutral Salts procurable, by means of Oil of Vitriol, not only of a bitter Taste, but also, purgative; of which kind is the *Arcanum Duplicatum*, or *Tartarum Vitriolatum*. But the natural Salts are more bitter, and their Parts more subtile; as plainly appears from hence, that these natural Salts readily dissolve in about an equal quantity of Water; whilst the artificial require four times their own Weight to dissolve them †.

Of saline
Springs.

95. Besides the above-mentioned purgative Waters, that abound with a bitter neutral Salt, composed of a chalky and an acid Principle; there are many others, as that of Ratzeburg, &c. which afford not only a calcarious Salt, but a considerable quantity of common Salt. And these

* *Viz.* The *Sal Mirabile Glauberi*.

† The *Rockelle* Salt, or Regenerated Tartar, may commodiously be used, in many Cases, instead of the Epsom or Glauber's Salt; as having a much more agreeable Taste, and a gentler purgative Virtue.

These kind of Waters are of use for cleansing the Stomach and Intestines of tough, viscid Humours; restoring the Appetite, promoting Digestion, and remedying such Cruditates and Flatulencies, as produce spasmodic Disorders in the Body. But 'tis not proper to drink them in any large quantity, or for any length of time; whence they are less suited to those Diseases which seat themselves deep in the *Viscera*, and proceed from Obstructions therein; because a long Use of Waters is required to remove such Obstructions from such fine Canals, whereof the *Viscera* consist. They may however be fitted for this purpose, by mixing and diluting them with other Waters*.

96. There are other Springs, which, upon the strictest Examination, scarce manifest the least Signs of a neutral or alkaline Salt, or of a mineral or irony Earth; and yet are highly valuable on account of their extreme Lightness and Subtlety: and of this kind there are several hot as well as cold Springs. A remarkable hot Spring of this kind, is that of *Toplitz*; where the Waters are extremely hot, and nearly resemble the *Piperine* Springs in *Rhetia*, which continue to run from the Month of *May*, when the Sun begins to dissolve the Snow upon the tops of the Mountains, to the end of *September*. And altho' these hot Waters of *Toplitz* hold not the least saline or earthy Matter; so that when mixed either with acid or alkaline Liquors, they preserve their natural Clearness, and after a total Evaporation leave no solid Substance at the bottom; yet they have considerable Virtues, upon account of their Purity and Lightness: in both which respects they exceed even fine rain Water. And hence they become highly serviceable.

Of simple Springs.

The hot Wells at Toplitz.

* Hence appears the Reason why the direct Salt-Springs are not considered as medicinal; except with regard to their purgative Salt, obtained from the Bitterp. See above, p. 86, &c.

serviceable, in the way of bathing, for the Cure of external Disorders: as in Contractions, Dryness, Rigidity, Stiffness, and want of Motion in the Limbs; by relaxing and strengthening the Fibres, and giving a due Circulation to the Blood and Spirits. They also prove beneficial this way; where the internal tendinous and nervous Parts are affected; as in hypochondriacal Disorders, the Cholick, the Asthma, Contractions and Distensions of the Limbs; especially if the Bath be not too hot, but lukewarm. Whence it is my constant Advice to have these Waters fetch'd home, and a Bathing-tub fill'd with them; because Persons cannot well bear the excessive Heat of the Bath; and therefore the Spring without the town, commonly call'd the Sulphur-Bath, is of much more frequent use, and found wholesomer; tho' excepting its temperate Heat, 'tis exactly of the same Nature as that within the town. And as all Physicians agree, that the lightest and purest Waters are the wholesomest; and as the *Piperine* Springs afford an eminent Instance hereof; no doubt but the *Toplice* Waters, tho' drank cool, may prove serviceable in many Distempers; notwithstanding the Custom of drinking them is not introduced, any farther than the mixing of them with Wine.

Other pure
and simple
Springs.

97. This Subtilty, Purity and Levity, is also the true Cause of the Virtue and Efficacy of some other Springs in the Cure of Distempers; and particularly the *Schlangenbad* Springs of *Hesse*, which contain no saline, earthy, irony, or other mineral Principle, that can by any Art be extracted from them; and are no other than an extremely simple, pure and light Water: which nevertheless, both by drinking and bathing, has very remarkable Effects. The same Reasons recommend the *Schleusing* Spring, called in the German Language,

Language, *Wilhelm's-Brann*; for these Waters have all the Marks of Purity and Excellence, and if put into the exhausted Receiver, throw up a bundance of Bubbles; do not grow thick, or precipitate any thing upon the addition of Oil of Tartar, a Solution of Silver, or Sugar of Lead; but deposite all their Impurities in passing thro' the Sand and stony Beds; receive no change from the common Experiments of Galls, Acids, Alkalies, &c. and when evaporated, leave no earthy Substance behind them. Hence the purer and lighter such Waters are, the more they should be esteem'd; as their Wholesomeness and Power of curing many chronical Disorders depends thereon: for thus they are fitted to enter the finest Vessels of the Body; and to dissolve and carry off viscous Humours.

98. From the several preceding Examinations it appears, that Mankind are liberally supplied with medicinal Springs, of different Natures, admirably suited to the Cure of different Distempers. Thus, for example, if the first Passages of the Body require to be cleansed of their grosser Excrements, there are numerous Springs that answer this Intention, beyond all comparison better than the purgative Medicines of the Shops: in particular, among the hot Springs are the *Caroline*, and those of *Aix la Chapelle*; and among the cold ones, those of *Egra*, *Sedlitz*, and *Ratzeburg*. If ferous Humours are to be carried off by Urine, the *Seltz* and *Embsene* Waters answer this Intention. If weak *Viscera* are to be repaired and strengthened, the *Pyrmont* Waters do it effectually. If gross and viscid Humours are to be discharged, and the obstructed *Viscera* to be relieved; if weak Fibres require to be strengthened, and the Kidneys and Bladder to be freed from stony Matter, the *Anonian*, *Wildung* and *Spaw* Waters.

The general Doctrine of the preceding Experiments with regard to internal Use.

Waters are soveraign for these Purposes. If the lines sharp, and tartarous Juices, which cause the Gout and Rheumatism, require to be dissolved and corrected, and the nervous Parts of the Body to be innocently relaxed and set to rights, the pure Waters of *Schlungenbad, Selin, &c.* promote this End, in the most effectual manner, especially if mix'd with Milk. Lastly, if corrosive, bilious Humours are to be rendered mild and temperate, and the weakened Tone of the Stomach and Intestines to be restored, the Steel Waters are of eminent Service in these Cases.

And external.

99. The external Use of mineral Springs is no less suitable to the various Disorders of the Body and its Parts. Thus, for Instance, when the Fibres of the external Parts are too dry, hard and crispy; bathing in the *Teplitz, Embress, Pöperine* or *Schlungenbad* Springs, relax, soften and render these Fibres pliable, better than any other Means hitherto known. Again, if the external Parts are too weak, slack and moist, the Steel Waters powerfully brace them up, dry, strengthen and confirm them. To conclude, when Swellings are to be dissipated, viscous and sluggish Humours to be dispersed or dried up, Blemishes and Foulness of the Skin, whether in the form of Scab, Tetter or Ulcer, to be removed, the *Caroline* and *Ain la Chapelle* Baths are found excellent.

The Conduct observ'd in these Enquiries.

100. Thro' the whole Course of our Enquiries into the Principles, Natures and Uses of medicinal

* Hence it should seem, that Nature has done for us all that Physicians aim at by their Dispensatories, and Collections of Receipts; viz. supplied us with a Set of easy, cheap, serviceable and safe Remedies; ready prepared to our hands; in such a manner as the present Pharmacy does not rival. And the farther this Enquiry into Mineral Waters is pursued, the more Intentions, we plainly find, are answer'd.

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cinal Springs, we have purposely avoided a large Apparatus of chemical and philosophical Experiments; and contented our selves with a few that are easy, simple and conclusive: thus avoiding an Ostentation which many have run into, and multiplied Experiments to no purpose: for 'tis labour lost to examine these Waters by mixing them with common Salt, Nitre, Vitriol, Alum, Copper, Brimstone, Orpiment, and numerous other mineral Bodies, since no such Experiments can manifest to the Senses any other Principles than what we have in our simple Method discovered; as will be evident to such as are well versed in natural and experimental Enquiries.

101. For the same Reasons we have purposely omitted the hydrostatical way of Trial, by means of Water-weighs or Hygrometers, &c. For tho' it might, at first, seem probable, that the Weight of Mineral Waters is thus discoverable, as it is in Wine, Malt-Liquors, Urine, common Water, and Lixiviums; yet whoever attentively considers it, will find this kind of Experiments very fallacious in Mineral Waters. For it appears, by repeated Observation, that the Hygrometer plunged into these Mineral Waters, when taken first from the Spring-head, floats high, and shews their Gravity greater than it is; and the next day, if plunged into the same Parcel of Water, it sinks lower, and makes the Water seem lighter. And as no one, that we know of, had before taken notice of this Phenomenon, we examined into the Cause thereof; and found it owing to the Presence or Absence of the subtile, expansive,

*Hydrosta-
tical Tri-
als, why
omitted.*

* Those who desire farther Light in this Particular, may consult Mr. Boyle on Colours, and Mineral Waters; and Dr. Hierne's Appendix to his *Acta & Tentamina Chymica*; where he treats of Colours and Precipitations. Edit. Holmiae, 1712. Pag. 140, &c.

expansive, aerial Principle, that plentifully abounds in these Waters, when fresh taken from the Spring, and buoys up the Instrument, as if it were so much Air striving to get out, and rising in Bubbles. But after this Spirit is exhaled, the Instrument no longer meets with the same Resistance, which kept it from its due Station; and therefore sinks down deeper. Whence it appears, that the elastic Power of Bodies may pass for Gravity; or that the Powers of Elasticity and Gravity are equal.

102. Neither does the hydrostatical Balance determine the precise Gravity of Mineral Waters, or the exact Quantity of their Contents, if we wait till this subtle elastic Principle is exhaled; for then the Waters commonly become turbid, and the okery Parts fall to the bottom: whence their true Gravity cannot be assigned. Much less can the Hygrometer examine the Gravity of Hot-Well Waters; because all Waters rarify, and become lighter with Heat: insomuch that if the Instrument be plunged into the Waters while hot, they seem to be extremely heavy, by making the Instrument float higher; but much lighter when cold, by suffering it to sink lower*.

SECT.

* The most exact, or least exceptionable way of determining the specific Gravities of mineral Waters, is, perhaps, that of Mr. Boyle and M. Homberg, by carefully weighing them in a Phial, with a long and slender graduated Stem; against an equal Phial filled to the same height with distilled Water: or if two such Phials cannot be procured, by weighing the Mineral Water, and the distilled Water, at two Operations, in the same Phial, furnished with its graduated Stem; wherein a drop of Water may rise to the height of the tenth of an Inch or more.

S E C T. III.

*The Objections to Mineral Waters considered:
and RULES laid down for rendering such
Waters safe, and effectual, in the Cure of
Diseases.*

I. **T**HOUGH the Virtues of Medicinal Waters *General*
are great, and their Use extensive; yet *Directions*
they have this in common with all other Medi- *for the Use*
cines, that their good Effects depend upon a *of Mineral*
proper Administration. To administer them pro- *Waters.*
perly, requires a Knowledge of the Circum-
stances both of the Patient and Distemper; so
as judicially to suit them in every Case. And
after understanding the Distemper, its Causes,
and the State of the Patient, there is nothing
more necessary than a thorough acquaintance
with the Faculties and Virtues of medicinal Wa-
ters, and the manner wherein they operate.
The Sum of this Knowledge not only directs to
the choice of such Waters as are best appropriated
to the Distemper; but likewise so disposes and
regulates their Use, that the desired Effect must
necessarily follow. On the contrary, if these
Particulars are disregarded, no wonder if they
who rashly advise the Use of Waters, should
thereby injure their Patients, unless by accident.
And yet 'tis certain, that these Waters are but
an Idol with many Physicians, or a thing whereof
they, without sufficient ground, believe and re-
late strange Fables. Many, in this particular,
are guided by a childish Superstition; and ap-
prehend great Danger from the use of such
H Waters;

Waters; so that they prescribe them only in desperate Cases, or as a last Remedy, in reputed incurable Diseases. But my Experience of them, in a Course of many Years Practice, besides the particular Experiments I have made to examine them, convince me, that these Apprehensions are groundless; that such Waters are, at the same time, the most efficacious and most innocent of all the Medicines hitherto discovered; and that they never fail of Success where the Physician knows how to apply them seasonably, and in the true manner. I will therefore, here deliver what I have observed upon the imprudent and unskilful Use of these Waters; the happy Effects I have observed upon the true way of employing them; and add the necessary Rules and Cautions for the Direction of others; that none, if possible, may hereafter complain they have used this excellent Gift of Nature in vain, or to bad purpose.

That the ways of examining Waters are not fallacious.

2. To strike at the Root of the Errors, which still prevail to the discredit of Mineral Waters, we must here consider the Ingredients whereof they consist; and by means whereof they act. There are some who suspect most ways of trying and examining the Nature of these Waters to be uncertain or fallacious. And it must be acknowledged, that there is no absolutely perfect Method of determining their precise Contents; by reason of the numberless Bodies they wash in the Bowels of the Earth. But on the other hand, no one that understands the true philosophical and chemical way of enquiring into Waters, will deny, that tho' we cannot precisely determine every Ingredient they may possibly contain; yet we may certainly discover and demonstrate the principal ones; and those, whereon their Operations and Effects depend. But let it be here observed,

observed, that whoever thinks to gain any real Knowledge in this Subject by consulting the Writings of the Ancients, will find himself greatly disappointed; and receive nothing for his Labour, but an absurd Collection of imaginary Principles. And yet 'tis surprizing, that even in the present Age, when such a great Light of Natural Philosophy is set up, there should be some, who thro' a Veneration of Antiquity, a Love of Contradiction, or I know not what other Reason, obstinately cleave to the Opinions of the Ancients.

3. 'Tis a prevalling Notion at present, among most of the Writers upon Mineral Waters, that they contain a Vitriol, like to the common Vitriol of Iron: which is the Opinion of the better, or more experimental kind of Writers. And in order to countenance this Opinion, they laboriously endeavour to prove, that Mineral Waters exhibit the same Phænomena as a Solution of that Vitriol in common Water. The Experiments they produce, on this occasion, are these.

The Arguments for Vitriol in Waters confuted.

(1.) That Mineral Waters, and common Water, impregnated with Vitriol, have nearly the same Taste. (2.) That both of them turn purple, upon a small addition of Galls. (3.) That both of them turn to a kind of Ink, with a larger addition of Galls. (4.) That neither of them will curdle Milk. (5.) That both of them grow thick with Oil of Tartar, and let fall a Sediment. (6.) That the Earth they both afford, upon Evaporation, as also the okery Sediment they spontaneously let fall, makes a considerable Ebullition with Spirit of Nitre; and sends out a Smoke, in the same manner as the Vitriol of Iron would do, in the like Case. (7.) And lastly, that the Salt, properly extracted from the insipid Earth, has a pale Colour, an irregular Figure,

and produces the same Effects as Vitriol of Iron. And, by these Arguments there are some who think they sufficiently prove the Existence of an actual Vitriol in Mineral Waters.

4. But this Opinion rests upon weak Pretensions; which need not all be separately considered, because they make nothing to the Proof of the Assertion; we shall therefore only consider the capital thing, which being overturn'd, the rest will fall of course. No one, who uses his Senses, can possibly doubt that there is somewhat of a vitriolic Nature in Mineral Waters; for not only the Taste, but the Sight confirms it, by their turning inky with Galls, &c. But the Question is, whether this vitriolic Matter be the same with the gross corporeal Vitriol in common Use: which has hitherto been proved by no Arguments, nor Experiments. For the vitriolic Matter in medicinal Waters is volatile*; but the common Vitriol fixt: so that their Nature and Operations are entirely different. Thus 'tis evident by numerous Trials, that the addition of Galls to the Waters of hot mineral Springs, causes but a very small change of Colour, unless the Water be fresh taken from the Spring-head: and when it has stood any time,

* This Volatility of the mineral Spirit in Steel Waters, is confirmed by Experiments made on the medicinal Waters of *France*; especially those of *Forges*; which are said to lose it in four or five days; whence, in them, it appears of a more fixed or irony Nature, than in several other Waters of the same kind. See *Histoire. de l'Acad. An. 1608. pag. 58.* But the Waters of *Passy*, in *France*, contain this volatile vitriolic, or rather pyritical Spirit, exceeding loosely; so that it flies off immediately upon their being taken from the Spring-head. See *Histoire. de l'Acad. Ann. 1701.* But the newly discovered Steel Waters of *Passy* in *France*, are said, even after having stood ill stopped for seven Months, to turn inky with Galls, as perfectly as at first, which shews the fixed Nature of their irony Principle. See *Histoire. de l'Acad. Ann. 1720, pag. 45.*

time, exposed to the open Air, it no longer changes Colour at all. 'Tis true, that in the brisk Waters of cold Springs, this Tincture appears blacker: but here also, the natural irony Taste immediately vanishes upon their being exposed to a gentle Heat, or the open Air; and they then no longer strike a dusky Colour with Galls. So that the strongest Steel-Waters, even those of *Pyrmont*, when heated, or suffered to stand in the Air for twenty-four hours, afford no Signs of a vitriolic Nature. Nor have those who argue so earnestly for a solid Vitriol in Steel Waters, been able, by their utmost Endeavours, from a hundred Pints of these Waters, to extract and exhibit to the Eye, a single Grain of Vitriol. For tho' *Helmont*, in his fourth Paradox, declares, that by the means of Distillation, he obtain'd a Vitriol from the *Spaw* Waters; yet this plainly appears to be one of his Pretences: as no other Person, by the same Operation, tho' ever so exactly perform'd, could obtain an actual Vitriol from them*. The Conclusion upon the whole is, that these kind of Waters really contain somewhat of an irony Nature;

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* It is very easy for a Chemist to fall into this Error, without having directly made the Experiment; for as all such Waters give evident Signs of their containing Iron, and were firmly believed of an acid Nature; the Conclusion, by bare reasoning, is, that they would afford a Vitriol by this Treatment. But such kind of reasoning should never be trusted. The only way is for Experiments to judge of things, and the Sense to judge of Experiments. See *Helmont's* Notion on this head refuted by Dr. *Lifter de Fontib. Medicat. Angliæ Exercit. prim.* cap. 6. pag. 40, 41 And even supposing an acid Spirit in Steel Waters, yet their irony Principle is not held dissolved thereby, as Iron is in an acid Menstruum which detains the Iron; whereas the Steel Waters soon let it fall, in form of Oker, to the bottom; and cannot, even by heat, without a new fermentation, be made to take it up again.

Nature^{*}; which being joined with a sulphureous Spirit, resembles common Vitriol only in the Taste and the Colour it gives, without any farther approaching to the Nature thereof: and consequently they err, who, upon hearing the Name of Vitriol mentioned about these Waters, judge of them, and decry them as abounding with the gross or common Vitriol of the Shops †.

5.

^{*} There is an Observation of M. *Lemery* which adds farther Light to this Matter. He found, by Experiment, that a Solution of Vitriol immediately turns black with the Tincture of Galls, and that Iron-Filings turn black much slower with the same Tincture; whence 'tis concluded, that the *Farges Waters* in *France*, are not vitriolic, but irony; because they turn black, not immediately, but after some time, with the Tincture of Galls. See *Histoir.* for the Years 1707 and 1708.

† The Author justly accuses many Writers upon mineral Springs, with feigning a real Vitriol in Steel Waters. The Errors of these Writers are principally owing to a want of Knowledge in Chemistry; and accordingly, when Persons well versed in that Art, such as Mr. *Boyle*, Dr. *Lifter* and Dr. *Slare*, come to treat of this Subject, they find no actual Vitriol in mineral Waters. And whoever desires to see this Point clear'd up, may consult the fifth Chapter of Dr. *Lifter's* first *Exercitatio de Fontibus Medicatis Angliæ*; where he shews the Origin, or slow Germination of Vitriol, and the calcarious Nitre: and in the seventh Chapter of the same Work, he shews, that perfect Vitriol is seldom or never contained in Mineral Waters; but that the Pyrites is totally soluble therein. We find indeed, in the Philosophical Transactions, N^o. 245, an account of a Mineral Water, at *Eglingham* in *Northumberland*, that yielded a real and genuine Vitriol. But upon Examination, the Vitriol was here found owing to the Waters running over a marcasite Bed, that had lain for some time exposed to the Air. For Marcasites yield no Vitriol whilst covered with Water; or without being exposed to the Weather. And *du Clos* assures us, that in all those Mineral Waters of *France*, examined before the *Royal Academy* at *Paris*, there appeared neither Alum nor Vitriol. But there is a Water near *London*, known by the name of the *Shadwell* Water; that seems, upon examination, to contain a large proportion of immature Vitriol; or to speak strictly, the pyritical Matter of *Newcastle-Coal*.

5. There is another Error deeply fixt in the Minds of Physicians, as if Mineral Waters, especially those of the cold, brisk kind, contain'd an acid Salt; as their common Name *Acidule* seems to imply: and, according to this Notion, their Virtues have been theoretically judg'd of, without Experience. This has been the constant Opinion of Writers upon this Subject, except *Gairius*, who, in the Year 1667, published a Treatise at *Paris*, entitled "The Secret of the *Acidule* newly discovered; in which the common Opinion of the Acidity of Mineral Waters is overthrown." But the Book itself no way answers its Title; but is full of Vanity, and promises more than it performs. There have indeed been some who allow'd of an alkaline Salt in Hot-Well Waters; but no one before my self experimentally prov'd it true of the *Acidule*, or brisk and cold Springs. For, tho' *Henricus ab Her*, in his Account of the Spaw Waters, expressly declares, that not only these, but most of the *Acidule* in *Germany*, made an Ebullition, and yielded a warm Fume, upon mixing with Wine; at the same time diffusing a grateful Odour, and throwing up numerous Bubbles, to a considerable height; yet this Author never suspected they abounded with an alkaline Principle, but declared himself for their containing an Acid. We have, in the preceding Pages, so fully prov'd the contrary of this Opinion, or the actual Existence of an alkaline Principle in these brisk mineral Springs, that it is needless to dwell longer upon it. And the same we have also done with regard to their fine mineral elastic Spirit; whereon their Virtues greatly depend.

The Notion of Acidity in Mineral Waters exploded.

6. We next proceed to consider the various Virtues of Mineral Waters, when used internally. And here we lay it down as certain, that their

That mere Water is medicinal.

Virtues are greater and more numerous, than those of any other Remedy, however specious or highly commended. A Knowledge of which Truth has given occasion to a considerable Error; for, hence many have presently ascribed the particular Virtues of these Waters to the Ingredients they contained; without allowing any thing considerable to the pure Water, or Vehicle, wherein the more medicinal Parts reside. But when, upon full Examination, I found, that neither the pure alkaline, or neutral Salts, nor the fine, elastic Spirit, with which these Waters are impregnated, were able to produce such Effects, or work such Cures, separate from the Waters that contained them; I discovered that the Efficacy of Mineral Waters, both in preventing and curing Diseases, was, in great measure, owing to the Water it self; and that the other Principles served only to quicken or stimulate its Operation. And this will appear more manifest from an exact Knowledge of the Laws of Circulation, Secretion, and Excretion in the Body. For as all the animal Juices require to be in a continued Motion; and as they necessarily consist of a large Proportion of an aqueous Fluid; 'tis agreeable to Reason and Experience, that nothing in Nature approaches nearer, or is more agreeable to them, than Water. And accordingly there are several Instances of Persons, who by a daily Use of Water for their common Drink, have prolonged their Lives to a great Age; and relieved themselves from stubborn Distempers. And no wonder; since Water is a Fluid capable of preserving all the Juices, and all the Offices of the Body, in their proper or natural State; preventing the more subtle, earthy, saline and sulphureous Particles lodged in the Juices, from introducing Putrefaction or Corruption; and capable of thinning and dif-

dissolving all the viscid, sizzly or tenacious Humours, that are apt to clog and obstruct the finer Vessels. In short, Water is that Fluid which assists and promotes all the Excretions, by Stool, by Urine, by Sweat, and other Outlets; so as to wash away and discharge all Matters prejudicial to the Body. *

7. What adds a Confirmation to our Proposition, is, that there are numerous Springs which afford no sensible Mark of containing a truly saline or mineral Principle, and yet have medicinal and curative Virtues; which cannot, therefore, be justly attributed to any thing so much as the Purity, Thinness, and Lightness of the Water itself. But then, as pure Water can have no considerable Effect, unless drank in a large quantity; since when taken in a small one, it often proves more pernicious than serviceable; and since to drink it in great plenty, might easily overburden Nature, or prove too much for the Power of the Body to dispense with, and thus produce Stagnations, Extravasations, &c. to prevent these Inconveniences, nothing can appear more proper than to quicken such Water with some saline, and active Matter: for such a Matter will not only stimulate the moving Fibres of the Body, and accelerate their Motion; but also help to dissolve any gross or viscid Humours, adhering to the Sides of the Vessels, and obstructing the Circulation of the Juices. Hence 'tis manifest, that the additional Efficacy of Mineral Springs, is considerably owing to such saline, active and spirituous Principles as naturally enter their composition: tho' we should not attribute more to these, than they deserve, or may, by Experiment, be demonstrated to perform.

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* See this Matter farther prosecuted, *Sett. V.* where Water is considered as an universal Medicine.

An Error from a Chemical Analysis of Mineral Waters.

8. From the same, false Notion of the Effects of Mineral Waters has proceeded another considerable Error: for there are many, even among Physicians, who conceive that the wholesomeness and virtues of these Waters can be so way so well judged of, as by the large quantity of Ingredients they afford upon Evaporation: without considering that the Fire is no trusty Operator in this case. For by means hereof, only the more fixed Principles of the Waters are made manifest; and not their subtle ones, whereon 'tis certain that a part of their Virtue depends. Thus the terrestrial, chaly Matter wherewith many Waters are loaded, rather hinders than promotes their desired Effect; especially when their Heat and spirituous Principle has left them. Whence the Waters of such hot Springs coming to cool, and stand for some time in the Air, if afterwards drank, occasion many Disorders, and pass not so readily, as when drank fresh from the Spring-head. And of this we have a remarkable Instance in the two *Caroline Springs* formerly mentioned.

That Waters are no violent Medicine.

9. Since, therefore, Physicians themselves have run into great Errors, with regard to the Principles and Powers of Mineral Waters; it is the less to be wondered, that from such false and theoretical Notions, several absurd and pernicious Opinions should have spread, concerning the Use of Waters. These Opinions we come now to examine, after having thus prepared the way. There are many who pass their Censure upon Mineral Waters from hear-say, without having ever visited the Wells themselves, or been Eye-Witnesses of their Effects; hence, after the common manner of Men, they fancy numerous noxious Ingredients in them, and boldly venture to declare them a kind of violent, dan-

dangerous Remedy ; which they currently stigmatize with the Name of a *Horse-Medicine* ; as a thing unfit to be used in any but robust Constitutions. But as great Authority as this Notion stalks about with, we shall make it plainly appear to be directly opposite both to Reason and Experience. And I would willingly know who can pretend that pure Water is a violent Medicine ? For certainly there is nothing in Nature more safe or innocent. I would next ask, what Medicine the whole Art of Physick affords more safe than Salts ; especially those of the neutral or alkaline kind ? What is more mild or gentle, and indeed more serviceable in weak Habits, than a subtile, astringent, or irony Earth ; mixt with a kindly Salt, and kept dissolved in the lightest and purest Water ? In the last place, I demand what can possibly add greater Strength to the Body, than a subtile, insipid, spirituous Fluid ? And yet these are the active Principles, which being kindly mix'd in medicinal Waters, give them all their Virtue. And hence they are so far from violent, that all their Operations are performed agreeably, and without disturbance ; so as when they purge, or vomit, to occasion no loss of Strength, no loss of Appetite, no Sickness ; even when they work in their strongest manner ; but rather raise the Appetite, strengthen the Stomach, and recruit the Spirits. When they pass by Urine, they occasion no Strangury or Sharpness ; but go off with a degree of Pleasure. When they operate by Sweat, they do it without occasioning any Faintness, or other Disorder. Nay, we have seen Persons of both Sexes, of the tenderest Constitutions, and labouring under Fevers, Bleedings, &c. Women newly delivered, and brought to the weakest State, undauntedly drink the hot *Caroline Waters*, without the least disadvantage ; but on the

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contrary, these Waters have excellently promoted all the Secretions, strengthened the Faculties, and finished the Cure. And so innocent are these Waters, that Children and Women with Child may use them with Safety and Advantage: nay Persons of delicate and tender Constitutions find them to operate with more ease, than the robust; and need employ them but in a moderate Dose. It must however be allowed, that the drinking of these hot *Caroline* Waters, which are not of an agreeable Taste, in so large a Quantity as that of ten or twelve Quarts a Day, is nauseous and disagreeable; but from hence to call this a *Horse-Medicine*, is arguing very unfairly; for 'tis no true Logick that would prove the Violence of these Waters, from the largeness of the quantity wherein some Persons drink them. *

The Preparation requisite for drinking the Waters in respect of Purging.

9. But tho' Mineral Waters, with regard to their Nature and Virtue, are an extremely safe and gentle Remedy; yet it frequently happens, by the ignorant Advice of Physicians, that they become a *Horse-Medicine*. For it is the preposterous Custom of some, either upon the Day the Patient begins his Course, or the Day before, to prepare his Body for the Waters, as they call it, by giving him some violent Purge. Surely whoever considers this absurd Procedure, will find it prejudicial almost beyond repair. For such is the nature of the stronger Purgatives of the

* The drinking of Mineral Waters in such immoderate Quantities, seems the peculiar Custom of *Germany*, and not adviseable but upon extraordinary occasions. We find in *England*, that two Quarts of the *Bath* Water is esteemed a large Proportion; and the general Stint is a Quart or three Pints. A Flask of the *Spaw* or *Pyrmont* Waters, drank at several Draughts, is with us a considerable Dose; and four or five half-pint Glasses of the *Tunbridge* Water, a Quantity generally sufficient.

the Shops, viz. Coloquintida, Rosin of Jalap, Scammony, Elaterium, Gamboge, &c. that by the virulent and caustic Principle whereon their Action depends, they may entirely pervert or destroy the Tone and Strength of the Stomach and Intestines; and invert their natural peristaltic Motion, by the immediate Contact they have with those parts. And how unseasonable this may prove, is manifest from hence; that nothing is more requisite towards securing the desired Effect of the Waters, than an unimpaired and entire Motion and Tone of these Parts. But the Use of such virulent and rough Purges is much more dangerous, and fatal, to those who are entering upon a Course of cold Waters; by which, all the Mischiefs brought upon them from such Purges, are rather increased, than removed, thro' the coldness of the Water: whereas the hot Waters, by their heat, in some degree help to moderate these Disorders, resolve the Contractions, and restore the inverted Motion. But the greatest mischief which arises from this violent Purging, and renders its ill Effects observable to the Eye, is that in a day or two after the first drinking of the Waters, they do not pass so readily as they otherwise would thro' all the Strainers and Outlets of the Body; by reason of the Constriction which such Purges leave behind them in the intestinal Tube, and Parts adjacent; after the same manner, as daily Experience shews, that the Body is bound, or rendered more costive, for several Days, after the Use of violent Purges.

10. But as the Abuse of a thing should by no means destroy its Use, we do not here condemn all sorts of Purging, by way of preparing the Body for a Course of Waters; but only those of the violent kind; which have a pernicious

cious Quality. Particularly 'tis necessary, in some cases, before the Course, to take a gentle lenitive Purgé, when the Intestines are clogged with a gross, viscid Matter; which might otherwise hinder the free Passage of the Waters, prevent their Effect, and bring on several Inconveniences. The same Caution is likewise to be used when Bathing alone is the thing intended; to prevent fresh Disorders, which, thro' such an Omission frequently happen, when Persons unwarily bathe in the hot *Caroline Springs*. But for this purpose, choice should be made of such mild Purgatives as, without disturbance, may cleanse the first Passages; viz. a Solution of Manna with Cream Tartar, or half an Ounce of *Epsom Salt*, dissolved in half a Pint of Water, or a proper quantity of any of the purging Water; which may thus be taken to advantage, a day or two before the Course is entered upon. But if the Body has long been constive, and the Excrements hardened in the Intestines, 'tis better to use an emollient Glyster or two, prepared of Mallow-Leaves, Marsh-Mallow Roots, or the like, boiled in Water-gruel, or Milk; with the addition of Oil, and a little Salt. But for such whose Bodies are open, or have not the first Passages blocked up by any large Collection of Humours, 'tis sufficient to dissolve in the first Glass of the Waters, about three Drams of the *Epsom Salt*; which wonderfully facilitates their Passage. Lastly, they who are sufficiently laxative already, require no Preparative at all.

II. That Error deserves no less to be censured, which leads Physicians, when the Course is over, to use violent Catharticks to purge off the Remains of the Waters; without a due Regard to People's Constitutions, or the Regimen necessary in this case. 'Tis indeed certain, and

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The Caution to be observed after drinking; with regard to Purgatives.

confirmed by Observation, that when Waters have been freely drank, for a great length of Time, they are apt to collect and stagnate in various Parts of the Body, but particularly in the Folds of the Intestines; and that such stagnant Waters should not be suffered to remain there; but rather be discharged. * This however is not to be done imprudently, or with loss of Strength to the Body; but by mild and gentle means: whence 'tis the Business of a Physician to make choice of such Medicines for the purpose, as best agree to the particular Constitution, Temper, and Strength of the Drinker. And upon this Foundation we do not absolutely reject the Use of the stronger Purges; but prefer such as act by no virulent Principles, yet have Strength and Briskness sufficient to perform the Work. And of this kind are principally Manna, in a large Dose, (quickened with any of the purging Salts,) Extract of Rhubarb, or Extract of Aloes: all which being very easily dissolved by the Fluids of the Intestines, act briskly without sticking to the Coats thereof, and without vellicating them.

* Riding on Horseback, or other proper Motion and Exercise, seems a good Expedient to prevent this ill Effect; and might therefore perhaps be properly used, at least after, if not during a Course of the Waters. But Dr. Stare is of Opinion that the Waters pass best, if the Person who drink them sit still, lie in Bed, or on the Couch. See *Philosoph. Transact.* N^o 351. This appears just with regard to their passing by Urine; but that not being the only way wherein such Waters act; and it being necessary in some Cases that they should also find their way thro' the Strainers of the Skin, and all the excretory Ducts; gentle Motion, and Exercise may be serviceable to that general Intention of the Waters; the making of them pass indifferently thro' all the Canals of the Body. But the Observations and Reasoning of Dr. Stare upon this Head, deserve to be farther considered; especially as enforced in his Account of the *Pymont Waters*, printed at London 1717.

them, or occasioning violent Gripings, Inflammations, &c. as Rosin of Jalap, Scammony, and Gamboge too often do; especially when given alone, or without their proper Correctives. But if any one is strongly attached to the use of these violent Purgatives, as thinking them more efficacious, let them be given in a small Dose, and along with a Dram or two of the *Epsom*, or other neutral Salt, to quicken their Operation and carry them off. For 'tis now a thing well known, how much these kind of Salts increase the Efficacy of the resinous Catharticks; inso-much that a single Grain of Scammony, or Rosin of Jalap, when mixed along with ten or fifteen Grains of a neutral purging Salt, shall operate better than six Grains of such a resinous Substance taken alone: and this with greater Ease and Safety. But where a Person has naturally a robust and strong Stomach, or intestinal Tube, wherein there remains a large quantity of the stagnant Waters; then, without dispute, a stronger Purgative is proper; and may be safely given, if the due Regimen be observed; that is, if the Body be well defended from all cold, the Patient kept in a warm Room, and both a little before and after the Operation, be directed to drink emollient Broths, Water-gruel, or the like, in order to defend the Stomach and Bowels from the corrosive Acrimony that might otherwise prove pernicious.

12. There is still another Error committed by Physicians, with regard to Purgatives, in the case of Mineral Waters: for some prescribe but one kind of Purge in all Cases and Constitutions; as if Nature had framed all Bodies to be relieved by one and the same Medicine. Whereas 'tis certain, that to render Purgatives successful, they must be suited to the particular Constitution and Disorder.

Disorder. Thus, for such as have the Tone of the Stomach and Intestines impair'd, such as are subject to Diarrhoeas, Women with Child, Women who have lately lain-in, &c. the proper Purgative is Rhubarb. Where the Humours are sharp and acrimonious; where the Body is subject to the Gout, Rheumatism or hypochondriacal Disorder, Manna and the neutral, purgative Salts are best. Where the Bile overflows; in order to lessen its quantity, and take off its heat, there is nothing better than Tamarinds. But to invert this Order, and give the contrary Medicines in the same Cases, must needs produce different Effects.

13. There is a Question often started, to the perplexity both of the Physician and the Patient, *viz.* Whether it be always necessary, after a Course of the Waters, to take a Purgative; before entering upon Bathing? To which we answer, that 'tis not always necessary: for if the Waters have passed off kindly, without leaving any Signs of Stagnation behind, either in the Feet, or Habit of the Body, and especially if the Course be used only as preservative, there is no necessity for fatiguing the Stomach, and whole Body, with repeated purging. And to speak a plain Truth on this Occasion, Physicians have rather an Eye to their Fees, than the Health of their Patients, in advising it. But the Case is quite otherwise when the Waters are not discharged in proportion as they are drank, and actually remain behind in the Body; or when the Stomach of hypochondriacal Persons is loaded with a Collection of viscid and acid Matter, from a want of Digestion: in these circumstances, purging must be recommended; unless we mean to expose the Patient to greater
 I Danger

Danger by the Use of the *Bath*. But here also the Purges should be of the mild and gentle kind, such as *Epsom Salt*, *Manna*, *Pilula Ruffi*, *Extractum Rudi*, or the like.

*Directions
about
Bleeding.*

14. Having thus settled the Matter of Purging; we proceed to the Consideration of Bleeding, with regard to its Service or Disservice in the case of Mineral Waters. There are still remaining amongst us many Physicians, who following *Eristratus*, *Helmont*, and others of that kind, pronounce from Authority, without Proof, that "Bleeding is a Remedy, of all others the most disposed to let out the Treasure of Life; and draw away the Receptacle of the Soul;" and therefore at once banish it the Kingdom of Physick. We shall not here enter into an Examination of this Opinion; but shew that Bleeding is often proper in order to receive Benefit from drinking the Waters, and sometimes highly necessary; so as not to be omitted without the greatest Danger. We do not however indiscriminately advise it to all Persons, but only to such as are too full of Blood and Juices; and particularly in the Case of Women, whose menstrual Discharges are stopt, either thro' Pregnancy or some Distemper; and to those Men who, being subject to an hæmorrhoidal Flux, find it stopped: again, to such whose Vessels, thro' the whole Habit of the Body, are full and turgid; and lastly, to such as are accustomed to high living and a plentiful Use of Wine, or have a florid Complexion and a full corpulent Habit of Body.

15. That the natural Fluids may readily pass thro' all the Canals of the Body, 'tis necessary the Vessels should not be overfilled with Blood. Thus we plainly find by Experience,

that

that in a full and florid Habit, the Pulse beats low, and the Excretions move languidly; but as soon as a quantity of Blood is taken away, the Pulse beats freer and stronger, and all the Secretions go on to better advantage. If therefore whilst the Body remains full of its own Blood and Juices, the Waters should be drank in a large quantity; they would not only move slower thro' the Vessels, but also stagnate and corrupt: and by Reason of this large additional Quantity, they might drive the Blood forcibly upon the more noble Parts; and thus produce Inflammations, Hæmorrhages, Obstructions in the *Viscera*, and many other Mischiefs: insomuch that Persons of this Habit, coming directly to drink the Waters, without losing of Blood, may risque their Lives. On the other hand, those who bleed a day or two before they enter upon this Course, have none of these Dangers to fear; but may drink the Waters with the desired Success: as is well known to those who have prudently observed the Effects of Mineral Waters. For 'tis a common Observation at the Wells, that Persons who found themselves ill upon first drinking the Waters, on account of their not passing off regularly, but oppressing and incommoding the Body, so far as to determine them to quit their Design; yet having, by the Advice of another Physician, lost a little Blood, they have not only been soon relieved from their Disorders, but entered upon their Course again to great advantage.

16. There are several Physicians who scruple *Objection* prescribing the Use of cold Waters to such as *to the* have weak Nerves, for fear of weakening them *drinking of* still farther. It must indeed be acknowledged, *cold Waters* and Experience manifests, that the most dan- *gers an-* *swer'd.* gerous

gerous Symptoms are frequently produced in the Body from external Cold; and that this happens in a much greater degree when the Cold reaches to the internal Parts, which are unaccustom'd to bear it. Thus we have Instances where the whole Body being suddenly cooled, has occasioned loss of Sight, and a trembling of all the Limbs; where the Administration of a cold Glyster has caused immediate Death; with other Instances to the like purpose. But, for these Reasons, totally to reject the Use of cold Mineral Waters betrays great Weakness. All that such Observations justly indicate is, if the drinking of these Waters cold occasions any bad Symptom, the drinking of them cold is to be forbid; and a Method of drinking them advised, which shall render the Water suitable to the weak State of the Body. And this I have for a long time very advantageously done, by directing Bottles of the Water to be plunged in *Balneo Mariae*, till they receive a degree of Heat more agreeable to the Body and the Palate; a small Hole being first made with a Needle in the Cork, to prevent the elastic Spirit, thus expanded by the Heat, from evaporating; and to keep the Bottles from bursting. Nor let it be apprehended, that this Treatment of the Waters causes an entire loss of the mineral Spirit, whereon their Efficacy depends; for as the Heat is not great, and as a proper Caution is here used, a sufficient quantity of the Spirit is still kept in. And tho' there be no need of farther Arguments, since Matter of Fact confirms the Truth hereof; yet we find that even the Waters of the hottest Springs, whose Heat is much greater than that here recommended, are not entirely destitute of this volatile, mineral Principle.

17. Having thus given the necessary Cautions and Directions, as well to Physicians as the Patients, with regard to entering upon a Course of the Waters; we now proceed to consider in what Distempers they are of more eminent Service than any other Remedy. But as the Catalogue of these Distempers is extremely large; we shall only speak to those wherein most Physicians rather think the Waters detrimental than advantageous; and shew the Erroneousness of this Opinion, both from Reason and Experience.

18. And first, the Use of Mineral Waters is held dangerous in violent Fluxes of the *Menses* and *Hæmorrhoids*. The Reason why Physicians forbid Waters in these Cases, depends upon a false Notion of the Causes of such Discharges, and of the Ingredients of the Waters; which they take to be metallic, vitriolic, and styptic: for having found by Experience that Astringents are prejudicial in such Cases, they hence forbid both the Use of hot and cold Waters therein. But as a Knowledge of the Blood's Circulation discovers the true Cause of these Discharges; and as the Apprehension of styptic Ingredients in Mineral Waters is groundless; this Opinion of theirs must be rejected as frivolous. A careful Enquiry into the Cause of violent Hæmorrhages shews it to be no other than an Obstruction to the free Circulation of the Blood in certain Parts of the Body. And thus the Blood having not its due Motion thro' the Canals, impacted Matters are of consequence generated in the *Viscera*, and the Obstructions necessarily rendered greater: whence the Blood coming to these obstructed Parts, in a still greater quantity, and finding no Passage, of course diverts, and breaks its way thro' other Parts,

Distempers wherein Waters, contrary to the common Opinion, are serviceable.

where it has either been accustomed to find vent, or meets with the least Resistance; whence it happens to be discharged with Violence in the Parts above-mentioned *. The first rational Intention therefore in the Cure of these Disorders, is to open the Obstructions of the *Viscera*; and to restore a free Circulation of the Blood therein. And this can no other way be so effectually done, as by the drinking of Waters, impregnated with a gentle stimulating Salt. For 'tis the Property of these Waters, by the large quantity of their aqueous Part, to dilute and thin the stagnating Humours, and render them fit for Motion; whilst by their saline Particles they dissolve the Viscidities, twitch and shake the Canals, and cause them to press, protrude and squeeze forwards their Contents. This appears to be the Rationale of the Case. And thus in fact *Henricus ab Eleer* † expressly declares, that “ The “ *Sparw* Waters are extremely well fitted for “ provoking the *Menses*, as appears by a thou- “ sand Instances; and yet are more successful “ than any other Medicine in stopping too large “ a Flux thereof.”

19. But that the Waters may, with the greater Certainty and Advantage, have this Effect, proper Care must be taken that the Body in such Circumstances be not charged with an immoderate quantity thereof; but the Water be drank in a small Dose, and not too hot. How necessary this Caution is, appears by an eminent Instance in the two *Caroline* Springs; where the Use

* There will now follow several Instances of the rational Method of discovering the Causes of Distempers, the Investigation of Remedies, and their right Application; the three things mentioned in the Introduction, as the Essentials of a Physician.

† *In Spadacren*, cap. 9. p. 83.

Use of the most temperate of them, call'd the Mill-Spring, has an admirable Effect in these Cases; whilst the common violently hot one, rather increases the Disorder. 'Tis also of great Importance, when the above-mentioned Fluxes are large, that both before, in, and after a Course of the Waters, all aloëtic and the stronger Purgatives be carefully avoided, which put the Blood into a violent Motion; and if any Purges become necessary, to use those that tare gentle, and of a strengthening Virtue; such as *Epsom Salt*, *Rhubarb*, *Sena*, &c.

20. And as these Waters have an extraordinary Efficacy in the stopping of Hæmorrhages; their Virtue is no less considerable in a Suppression thereof: a Truth that can be questioned by none, but such as have never attended at the Wells. For since a Stoppage of these natural and critical Discharges of the Blood, proceeds entirely from an Obstruction, or spasmodic Contraction of the Vessels, thro' which it uses to run; Mineral Waters are wonderfully adapted to restore and promote these Discharges: it being the Property of such Waters to flow to the Extremities of the Blood-Vessels, and there soften, or attenuate the grosser Substances that block up the Passages, and force it away by the elastic Property of their aerial Spirit. And, at the same time, by the large quantity of their pure aqueous part, they relax the harden'd and contracted Fibres; and thus again open the accustomed Passage to the Blood. To confirm this reasoning, I shall here insert the History of an extraordinary Case, whereof my self was Witness; and I chuse it as a singular Instance, out of a very large number to the same purpose. A Person of Distinction, about fifty Years of Age, of a Constitution betwixt sanguine and bilious,

*Suppression
of the Men-
ses and
Hæmor-
rhoids.*

long used to a Court-Life, Wine, and a high irregular Diet, was seized with the Gout and hæmorrhoidal Flux, returning at stated Periods; but without being much incommoded thereby, so long as he continued to open a Vein at proper Seasons. But being, a few Years ago, advised by some Physician or other, to leave off bleeding, under pretence of growing in Years; and following this Direction he was, in the Summer-Season, afflicted with a violent Colick, extreme Costiveness and Pain. His usual Physicians little suspecting the true Cause of the Distemper, ascribed it to the Gout struck inwards; and therefore rejected bleeding, as a perfectly useless, or dangerous thing. Another Physician being call'd, and enquiring narrowly into the Cause of the Disorder, immediately order'd the Patient to have a Vein opened in his Foot, and to use emollient Glysters. Upon this, the Violence of his Pain was immediately lessened; and growing better by degrees, he was carried, at the proper Season, to the *Caroline Waters*; by the internal and external Use whereof, he happily recovered the periodical Return of his Hæmorrhoids and Gout; and was perfectly cured of his Colick.

Gonorrhœa.

21. From too large Discharges of the Blood-Vessels, we pass on to the immoderate ones of the Lymphatics; the more common whereof are the *Gonorrhœa* and Gleet in Men, and the *Fluor albus* in Women. With regard to Distempers of this kind, many Physicians imagine that Mineral Waters are improper. But *Henricus ab Heer*, in his time, clearly remarked the Falsity of this Opinion; and declared that, how doubtful soever others might be in the Point, the *Spaw Waters* were certainly serviceable in the virulent *Gonorrhœa*; and produces Instances of his

his own Knowledge to confirm it. * 'Tis however certain, that these kind of Fluxes are generally increased by the Use of Mineral Waters ; whence their Disrepute in such Cases seems to have proceeded. For, whilst Physicians remain'd ignorant of the Causes of these Disorders, they attributed this Increase of the Flux to an Increase of the Distemper. But as the present Discoveries in Anatomy have given much better Light into the Seat and Nature of such Distempers, 'tis proper the Cure of them should be regulated accordingly. An obstinate *Gonorrhœa* or Gleet in Men, generally has its Rise from the unskilful Cure of a common venereal Running ; which corrodes the Prostate Glands, or others belonging to the Parts of Generation ; and renders them schirrhous and fistulous. An inveterate *Fluor Albus* sometimes proceeds from an acrimonious Humour, generated by a too violent or frequent Use of Venery ; or from a Humour, introduced in the way of a communicated Taint, which afterwards infects the Glands of the *Vagina*, so as not only to make them discharge their Juice in plenty upon the adjacent Parts ; but the same Juice being also infected, eats and corrodes the fine Fibres of the Parts it passes over ; and thus occasions sharp darting Pains, Excoriations and Ulcers ; whence proceeds the Matter of a virulent Flux. From this account, which is taken from Dissections, it appears, that in order to wash away, dilute, and weaken these infected Juices, soften the hardened Glands, strengthen the Fibres that are fretted and corroded, and join them again with the other untainted Parts, a Course of Mineral Waters is highly proper. And tho' it be true, that whilst the Course is in hand, the Flux will increase, yet when the Course

* Spadacr. cap. 9. pag. 80.

Course is over, there ensues a more certain and confirmed Cure. But in order to this end, balsamic Remedies, and a moderate Decoction of the drying Woods, are to be used during the Course ; by which means the Cure may be surprizingly facilitated.

*Glandular
Diseases.*

22. And no less serviceable is a Course of Mineral Waters towards the Cure of Distempers seated in the Glands of the Body ; whether proceeding from Obstructions or Relaxations of the glandular Parts. For such Waters have a very opening, diluting, resolving, absterfive and strengthening Quality. To gain the better Credit to this Assertion, we shall here subjoin the History of a curious Case, that happened lately. A *Portuguese* Lady, of a noble Family, requiring of her Physician a Purgative by way of prevention, he officiously prescribed her an Electuary ; upon the use whereof she soon fell into a violent Salivation, that continued for almost eight Months, till it had brought her to the extreme Weakness, and rendered her almost like a dead Carcass. The *Caroline* Waters were advised her ; by the Use whereof, both internally and externally, with the assistance of gentle Purgatives, at proper Intervals, she not only got rid of her spitting, but quickly recovered her former Strength and Beauty. It was remarkable in this Lady's Case, that after her Cure was compleat, she, by sitting longer in the hot Bath than was directed, had nearly relapsed into her spitting ; and doubtless would have done, if her Physician had not immediately prevented the Mischief by proper Purgatives.

*Diseases of
the Lungs.*

23. It is a current Opinion, that the drinking of Mineral Waters proves prejudicial to the Lungs, and increases all the Disorders thereof. The Origin of this Error is apparently owing to a

false

false Notion of the Ingredients of these Waters ; and an improper Advice of them to such Persons whose Lungs were already ulcerated or in part eat away : whence the Ignorance of Physicians has pronounced them prejudicial in pulmonic Disorders. It is manifest by Inspection and the Anatomy of tabid Bodies, that most Distempers of the Lungs arise from an Obstruction and Hardness of the Glands, wherewith this part so plentifully abounds. Whence proceed inveterate Coughs, Phthisics, Difficulty of Respiration, Asthma's, &c. in all which Diseases, the primary and sole Intention should be to open and dissolve away the Obstructions and Schirrhosities in the Lungs, that cause the Distemper. And this can by no other means be so readily effected, as by a Course of Mineral Waters. But to prevent their saline Acrimony, which is certainly unsuitable to the delicate spongy Substance of the Lungs, from doing mischief, it is adviseable to mix the Waters with Asses Milk ; which Experience shews is the best for this purpose ; or else with Goat's Milk. And to mix the Waters in this manner, not only blunts and mollifies their saline Particles, but also conduces to temper and sheath the Acrimony of the whole Mass of Blood ; so as to render them eminently serviceable in Diseases of the Lungs. We have seen numerous Instances of their good Effects, so drank in these Cases ; but shall here single out only a late one, for an Example. A maiden Lady about twenty, naturally of a florid Habit, had lost her Complexion ; her menstrual Discharges were obstructed, and she was troubled with a Cough, especially Night and Morning. This Cough proved so violent, that it frequently occasioned her to vomit and bring up a little Phlegm, with the utmost difficulty. She was
costive

costive all the time. But upon drinking the hot *Caroline Waters*, for three days, she grew sensibly better ; her Cough abated : and when her Course was ended, she returned perfectly cured.

*Diseases of
the Viscera.*

24. What I said above as to the Diseases of the Lungs, may also be extended to the other *Viscera*, and Diseases of the lower Belly. The Writings, and common Discourses of Physicians are full of the Mischiefs which they suppose Mineral Waters bring upon the *Viscera*. And indeed the Use of these Waters cannot be recommended where the *Viscera* are corrupted or highly tainted ; where the Humours are extravasated, on account of Vessels broke either in the *Thorax* or *Abdomen*, or where Imposthumations are formed : to prescribe the drinking of the Waters in these Cases, is to increase the Disorder, and hasten Death. But this Restriction does not reach to all the Diseases of the *Viscera*. The greatest number of chronical Distempers, which come on slowly, and prove of long Continuance, proceed from an Obstruction in these Parts, and a hindrance to the Circulation of the Blood : for the Prevention or Removal whereof, there is nothing more serviceable than Mineral Waters ; which preserve the *Viscera* in their natural State, and open Obstructions. Thus they are admirably preventive of the Scurvy, the Asthma, Abortion, Sterility, the Dropsy, and the Stone ; curative of an ill Habit of Body ; and lessen a present Fit, as well as prevent an approaching Fit of the Gout. And all this is attested by Experience and Observation. Whence it clearly appears, how idle and childish that Fear is, which many Physicians indulge, of the pernicious Effects of these Waters : tho' it is true, they have always at hand certain ingenious Comparisons and Instances of like Cases, as they call them,

them, which they use, on all Occasions, with a plausible Shew to the People. But whoever desires to see these Men painted to the Life, may consult *Baglivi*; who tells us, that "such popular Parallels are esteemed only by ignorant Physicians, and such as direct their Course not by any Rules of Reason, and Laws of Nature; but rather by the Rules of some fictitious and incomplete Similitude or Resemblance *."

25. Having thus considered the internal Use of Mineral Waters, we proceed to consider them in their external Uses; so as to point out several Errors therein, whereby both the sick and the sound are frequently endangered. What a Variety of Mischiefs are occasioned by the imprudent Use of Mineral Baths, is the common talk in all Places: but we meet with these Complaints no where oftner than at the *Caroline Springs*; which have this peculiar Virtue above all other Hot-Waters, that they do not relax the Body; but rather, by reason of the copious earthy and astringent Matter they contain, bind up the Parts, strengthen those that are weak, block the Pores; and thus produce a quite contrary Effect from other hot Springs. This Particular being not attended to by such Physicians, as, without a due regard to the Distemper and Constitution, indiscriminately advise their Use, may produce infinite Mischiefs. In particular, these Waters are highly prejudicial to Persons of a delicate and tender Habit, where the Body is foul or affected with spasmodic Disorders; such as the hypochondriac Melancholy, and the Colick; where the Surface of the Body is broke out in Spots; where there are Diseases in the Joints; where the *Menses* or Hæmorrhoids are flowing; where Persons are subject to the Head-

Bathing in the Hot-Wells, to what Distempers suited.

* Bagliv. Prax. Lib. i. Cap. 6. §. 4.

Head-ach, Palpitations of the Heart, or labour under venereal Disorders; and in numerous other Cases, which are prudently guarded against by *Wedelius*, in these Words: "The hot Baths
 "are of use where the Limbs are to be streng-
 "thened, where the Ligaments and Tendons are
 "to be gently excited to Motion, and where the
 "Body requires to be dried. But Care must be
 "had to prevent their reducing the other Limbs
 "to Extremity; whilst, by drying too much,
 "they deprive them of their Motion *." Physicians and others have frequently been surprized to find, that tho' every thing has answered to Expectation in a Course of drinking these hot Waters; yet at length, when the Patient quits the Bath, he finds himself as bad as ever, or perhaps worse. But this unexpected Change is easily accounted for, from what is above delivered. For, during the time the Patient continues to drink, bathing cannot excite those Disorders in the Body; because the internal Use of the hot Water resolves and prevents these Constrictions, and other ill Accidents, produced by the Bath; and again expels and throws out of the Body that which was driven from the external to the internal Parts. But this is no longer the Case when the Patient ceases to drink.

26. What we have here said relates only to the violently hot *Caroline* Spring Waters, which contain a large quantity of an astringent chalky Substance; whereas that other, called the *Mill-Spring*, is a more pure and subtile Water, that may be used with greater Safety. As therefore the former is so dangerous, 'tis better for those Physicians who have not a true and exact Knowledge of its Power and Effect, nor understand how to direct and distinguish its Use, ac-

cording

* *Amœnitat. Mat. Med. Lib. I. Sect. III. cap. xi.*

according to the different Circumstances of Cases, entirely to refrain from prescribing it; and recommend in its stead such hot Waters as are less powerful, but more safe. And a principal Spring of this kind is that of *Toplitz*; which is deservedly famous for softening, relaxing and opening the external Parts of the Body. For, by a strict Examination, it clearly appears that these Waters contain scarce any calcarious Matter, at all; so as neither to conflict with Acids, nor turn turbid and precipitate with Oil of Tartar: but owe their Excellence to their particular Lightness and Purity. Whence they may safely and efficaciously be used for resolving and dissolving hard Tumours, for restoring contracted Limbs, and softening and relaxing a dry shrivelled Skin. Besides this, there are several other Waters of the same Virtue, that may, for these Purposes, be used with the utmost Safety; as not abounding with any earthy Principle, and containing nothing besides a light and pure Water.

27. There is likewise a great Error frequently committed in using the Bath too hot; which thus violently heating the Blood, disturbs and expands the Humours: whence no wonder, if this Procedure gives Palpitations of the Heart, a Pain in the Head, Weakness, Faintness, and a sinking of the Spirits. This Mischief is also highly increased, if the Body be full of Blood and Juices, or turgid with ill Humours; for thus upon entering a hot Bath, a greater Bulk of the Fluids is driven against the Solids, to their prejudice: and when the Juices are foul, and come to be subtilized by the Heat, they are rendered sharper, more pungent and corrosive; whence they must of necessity prove more mischievous to the Body. For these Reasons, the Bath must be carefully managed.

Cautions
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so as to be kept barely tepid, or equally warm; and if it be necessary to continue long therein, hot Water should now and then be admitted, to prevent its growing too cold.

The Regimen to be observed in a Course of the Waters.

28. In the last place, I shall say a word or two of the proper Diet and Regimen to be observed in drinking the Waters. For as no Remedy, without a proper Regimen, can have its Effect; so a Course of Mineral Waters requires an exact Care in this Particular. There are two Errors generally committed by the Drinkers; viz. indulging themselves either too much, or too little. Some Physicians are so scrupulous as to forbid the Use of all acid, saline and spicy Meats; tho' perhaps these alone are pleasing and agreeable to the Patient: but the point of Exactness is here, for every one not greatly to recede from his usual Custom; otherwise the Appetite may be hurt, Digestion not well perform'd, or Crudities and new Disorders generated. Others, who have a principal regard to the Stomach, only advise the Use of spirituous and aromatic Things; which is a great hindrance to the business of Excretion: for common Experience testifies, that such things bind up the Belly. Above all, Voracity, and turbulent Disorders of the Affections, should be prevented, as great Enemies to Digestion; whence the Body is loaded with an useless Weight, and the Waters render'd ineffectual for subduing and discharging its Crudities. The Stomach also will be weakened and relaxed by this Procedure; and the Waters now plentifully drank, remain longer therein; and thus give rise to many Inconveniences. How destructive the turbulent Passions of the Mind are, appears from daily Experience in a State of Health; and unless well regulated, will prove more pernicious in a sick State, and a Course

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Course of Waters, whereby the Humours and Foulness of the Body are put into motion; so that Apoplexies, Palsies, and the like nervous Distempers, have proceeded from a Misconduct in this Particular. To conclude with a wholesome Admonition: Infirm Persons should not rashly venture upon a Course of drinking, or bathing; especially without observing a proper Regimen.

S E C T. IV.

Of the Correspondence between the Medicinal Waters of HOT and COLD SPRINGS.

1. **I**T may prove of some service in the Art of Medicine, to shew the Affinity there is between the Waters of hot and cold Springs. That there should be a great Relation between them may at first seem strange; especially as the common Opinion inclines to the contrary; and as the Ancients have not a word upon the Subject. Yet, from an exact Enquiry, it will appear, that these Springs have not only an Affinity; but even an Equality in their Origin, Principles, and medicinal Virtues.

2. Philosophers are divided about the Origin of Springs; some deriving them from the Sea, and the central parts of the Earth. But this Opinion being contrary to the Laws of Mechanics, Hydrostatics, and Reason, it is deservedly rejected. On the other hand, 'tis evident to the Senses, that all Rivers and Springs may proceed from the Regions of the Air: for Rain, Snow,
K
Clouds,

*The Origin
of Springs
and Ri-
vers.*

Clouds, Mists, Dews, and Hoar-frosts, actually afford a large Supply to Springs and Rivers; whence they rise higher when Rain falls in greater plenty; and approach near to a State of Dryness, in great Droughts. Add to this, that many Springs rise in Vallies, and low Places, on account of the Waters transfusing thro' the Banks of the higher Rivers; or are formed by others, seated on the Tops of Hills and Mountains; where the Rains fall and strain thro' numerous Windings of the Earth, 'till at length they collect, and rest upon a solid or stiff bottom, as that of Stone or Clay; which keeps them from descending lower: so that upon increasing, they can only now rise upwards; and thus discharge themselves in the manner of a running Spring. This, upon an examination of the whole Matter, appears to us the true and genuine Origin of Springs. And in this manner Springs continually overflow, and discharge their Water; whilst that which comes later to the Receptacle, drives away the former: and thus they form Brooks, which are often increased by the falling of Rains, and the Torrents of melted Snow, so as, in time, to wear themselves Channels in the Earth; and meeting with other Brooks in their Passage, at various distances from the first Spring-head, they unite therewith, increase their Stream, and now wearing a wider and a deeper Channel, make Rivulets and Rivers, even those of the largest kind; which spreading wide, at length pour into the Sea all that Mass of Water which had first fallen out of the Air. And for the Origin of those Springs, which are sometimes found on the very Tops of Mountains; it may justly be ascribed to the Condensation, Resolution or Distillation of the Clouds in those exceedingly high and cold Places.

3. As, therefore, Springs originally arise in high Hills and Mountains, we must next examine what Matters are contain'd in the Caverns of such Mountains, capable of mixing themselves with the Waters; and communicating a medicinal Virtue thereto. And here we must reject the nobler Metals, Gold and Silver; the Mines whereof are extremely rare, over the Globe: nor can the firm and compact Texture of such Metals be dissolved by the Water, or impregnate it with any medicinal Quality. It is manifest to the Eye, that Mountains consist of several Beds or *Strata*, the principal whereof are sandy, stony, calcareous, clayish or marly; and of all the number, the calcareous Matter is that which Water imbibes the freest. The lower parts of the Earth plentifully abound with Beds of Iron-ore, Oker, and Pyrites, or sulphureous Marcasites. For as Iron is of such necessary use, that Men could scarce subsist without it, Nature has spread a very large supply of Iron-Beds over almost every Country. Thus Stones, Clays, yellow Earths, and most mineral Bodies, are capable of affording Iron. Mountains likewise plentifully abound with Sulphur; the Ore whereof is found in many Parts of *Germany* and *Italy*; and if properly treated, it yields the common Brimstone; which is very seldom found pure and native in the Earth. The Production of Vitriol is also owing to the sulphureous Marcasites; from which 'tis every where prepared by Art. Lastly, that mineral Gas, or Sulphureous Vapour, which pervades every part of the Earth's Crust, and the Bowels of Mountains, appears to be the thing that works the Changes upon all Mines and Minerals. This Gas is frequently perceived by the Miners; and threatens them with Suffocation. Its Origin is owing to the sulphureous Marcasites,

*The Strata
of Moun-
tains, and
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or Pyrites, which by their intestine Motion, and the mutual Action and Re-action of the Principles whereof they consist, breathe out the Gas, or sulphureous, pungent, volatile Vapour, we speak of.

The sensible Principles of Springs, viz. Iron.

4. Having thus taken a Survey of the Materials lodged in the Bowels of the Earth, capable of impregnating the Waters that run upon them; we come next to examine what Matters, or Principles, can be exhibited by a chemical or philosophical treatment of the hot and cold medicinal Springs. And first, we find that nearly all of them, whether hot or cold, participate of an irony Earth; as appears not only by their rough, astringent Taste; but also from the okery Sediment they depose, or throw off upon the Pipes, thro' which they pass, and the Confines of the Spring-head. For we have seen no medicinal Spring, whether hot or cold, that has not afforded this kind of Oker; or solid Matter of a yellow Colour: which, when well wash'd and calcin'd, becomes a Powder, the Particles whereof are readily attracted by the Loadstone. Even the cold Springs, which have no pungent Taste, but seem to contain little more than a pure Water, are generally found to hold a few Particles of Iron, that occasion them to turn purple with Galls, and gives them their strengthening Virtue.

Fixed Salt.

5. What farther shews the Correspondence betwixt the hot and cold mineral Waters is, that they both afford a true alkaline Salt; which makes a Conflict with Acids, and has all the same Effects as other Alkalies. This I have not only experienced in the Waters of Germany, such as the *Caroline*, *Aix la Chapelle*, &c. but *M. Pascal* also confirms the same of the *Bourbon* Waters in *France*; and declares, in his Treatise of Mineral Waters, that, by joining this

Salt

Salt with an Acid, it became a neutral Salt; that it precipitated a Tincture of Coral made with an Acid; and dissolved coagulated Milk. The same thing is likewise confirmed by others, and particularly by Dr. *Gracchius*, chief Physician to the King of *Sweden*: for tho' there are few mineral Springs in that Country, yet this Author has solidly demonstrated the Existence of an alkaline Salt in a particular cold and brisk Spring of that Kingdom. It appears therefore that both the hot and cold Mineral Waters agree in containing an irony Substance, and an alkaline Salt.

6. The next Point to be considered is, whether they both contain the subtile, volatile, mineral Principle. And we assert, that all medicinal Springs, whether hot or cold, do contain it; and in proportion to the quantity thereof, have a greater or less Effect upon the Body. The same Experiments and Observations that manifest its Existence in the cold Waters, do it likewise in the hot: upon which we have largely insisted in our first Section. There is however this Difference between the hot and cold Waters, that the volatile Principle remains longer in the latter, than in the former; on account of the Heat that dissipates it sooner. *Ætherial Matter.*

7. To account for the Origin and Production of this fine volatile Spirit, and the Cause of Heat in Mineral Waters, is no easy matter. *Origin of Heat in hot Springs.* The Hypotheses hitherto advanced for this Purpose, seem all of them insufficient; excepting that of the curious Naturalist Dr. *Lifter*, with whom we here agree; as he proceeds upon the footing of Experiment and Observation. This Author deduces the Cause of the subterranean Heat, as likewise of Earthquakes, Vulcano's or fiery Mountains, from the sulphureous Marcasites heated and kindled in the Bowels of

the Earth. This Position receives great Light and Confirmation from the known chemical Experiment, of mixing together equal Quantities of Brimstone and Iron-slings, and making them into a kind of Paste with Water; wherewith the Ingredients being sufficiently moistened, produce both Heat, and, if the quantity be large, actual Fire. For, when the Mass is thus prepared, and suffered to lie for twenty-four Hours, it ferments, heats, swells, and changes Colour; and being now taken out, broken to pieces, laid again on a heap, and exposed to the open Air, it soon smoaks and breaks out into Flame. As Marcasites, therefore, do certainly abound plentifully in the Earth, and consist of Iron and Sulphur, wrought into a Mass; 'tis hence obvious that a large Bed of them, lying under ground, and being moisten'd by the Water that runs over them, will produce a Dissolution of the Principles whereof they consist; whence, by their mutual Action and Re-action upon one another, there may arise a very intense Heat and Swelling, capable of bursting out into open Flame, upon the Access of the external Air; where any Cracks, Fissures or Caverns of the Earth admit it. For 'tis Air alone that can animate secret and concealed Fire into manifest Flame. And thus the Fire prevailing in the dark Recesses of the Earth, may easily heat, in a greater or less degree, the Waters that run by it; according as they approach to, or recede from the Places where it spreads: whence Waters may come with different degrees of Heat, or Coldness, to the Spring-head.

*Origin of
the Spirit
in Waters.*

8. To these sulphureous Marcasites, and their mutual Action upon one another, may be attributed (1.) the mineral, sulphureous Spirit, (2.) the alkaline Salt, and (3.) the subtile, vitriolic Principle

Principle of medicinal Waters. For, the Vapour which arises from burning sulphureous Marcasites, is of an extremely penetrating, simple, and highly elastic Nature ; so as readily to enter and mix itself both with the hot and cold Waters in their Passage : it being the Property of all Waters easily to receive, lodge and detain, dry and subtile Exhalations ; as evidently appears from the Instances of pure Vitriol, Nitre and Salt, which are dry, acid Fumes, collected and concentrated in an aqueous Fluid.

9. That there should be both cold and hot medicinal Springs may happen in this manner. When the Waters take their Course near to these Beds of burning Marcasites, they thence are heated ; but if the Marcasites lie deep, and their Bed be not large enough to afford an actual Fire, but only a heated Vapour ; this Vapour breathing upwards, thro' the Cracks and Fissures of the Rocks, and Pores of the Earth, may insinuate itself into the cold Water, running high above the Bed ; and thus produce a cold medicinal Spring. And hence it is, that generally, there are cold Springs found adjacent to hot ones ; and a large Discharge of sulphureous Vapours about both hot and cold Springs.

10. It may here be demanded, why, if this mineral Spirit be owing to the Fume of Sulphur, it has not the same fetid Smell as common Brimstone ? This Question is easily answered. For a Difference must be made between the common Sulphur, artificially extracted from its Mine, or Ore ; and the pure native Sulphur, found in the Earth's Bowels. The common Sulphur of the Shops, is extracted by means of a culinary Fire, either of Wood or Pit-coal ; whence the pure native Matter of the Sulphur is mix'd in with an empyreumatical Oil, with which all burnt Wood

and Coals abound : whereas the native Sulphur, that has not felt the Fire, is not tainted with this empyreumatical Mixture ; but remains of a simple Nature, without any disagreeable Odour : as may be illustrated by the following Experiment. If an Ounce of Iron-filings be put into a glass Phial, and a quantity of pure and strong Oil of Vitriol be dropt upon it, and mixed therewith, then three parts of Water be added to the Mixture ; there immediately arises a violent frothing Ebullition : and at the same time a most pungent sulphureous Vapour endeavours to break out ; so as scarce to be contain'd in the Phial, by the Strength of the Finger. But if this Vapour be a little held in by the Finger, pressing upon the Orifice of the Phial, and a flaming Candle be applied to the Neck upon removal of the Finger, there immediately bursts forth an Exhalation, with a Crack and a Flame resembling Lightning. And yet this Vapour, though totally sulphureous, has nothing of the fetid Smell of Brimstone. And perhaps, if a way could be found to obtain a large quantity of this Vapour or Spirit, it might prove answerable, in Virtue and Effect, to the volatile, ærial Spirit of Mineral Waters *.

*Generation
of the fixed
Salt in
Waters.*

II. We now proceed more particularly to examine into the Origin and Generation of the fixed Salt contained in these Waters. It is to this Day a prevailing Opinion amongst Philosophers, Physicians and Chemists, that there is naturally no such thing as an actual and native, alkaline Salt, either fixed or volatile ; and that such a Salt is only producible by Art, and the help of Fire. But this Opinion is contradicted by

* This affords a Hint for imitating some of the natural Mineral Waters by Art ; and obtaining a mineral Spirit, if it can be caught.

by daily Observation and Experience; for the Waters, both of hot and cold medicinal Springs, do, without any Addition, and only by a proper Treatment, afford a copious fixed Alkali. Besides, those who are conversant in the History of particular Countries, must know, that in certain Parts of the East, and especially in *Egypt*, there is dug up from the Earth a large Quantity of alkaline Salt, which the Ancients called by the Name of Nitre; and is such as the Artificers use for the making of Soap and Glass *.

12. The Questions to be here considered are, whether the alkaline Salt contain'd in Mineral Waters, proceeds from the Entrails of the Earth; and, whether it may properly be called the Nitre of the Ancients? There are many Reasons against the Affirmative of these Questions; particularly because we no where in *Europe* † find any dry, alkaline Salt under ground: nor do any other Springs contain it, besides such as are medicinal, and impregnated with a Mineral Spirit. Whence we are obliged to seek for its Origin elsewhere. Upon a careful Examination of the matter, we conceive this alkaline Salt proceeds from the Mineral Spirit these Waters contain; which, by means of its latent Acid, joining itself with the calcarious Earth they contain, thus degenerates into a Salt, exactly resembling alkaline Salt. For 'tis manifest, by a variety of chemical Experiments, that Salts of an alkaline Nature may be made from Quick-lime, Chalk, Plaister of *Paris*, calcarious, and all kinds of alkaline Earths, by mixing them with acid Spirits; or even with an aluminous, vitriolic, or muriatic Salt: and these artificial alkaline Salts exhibit

* See *Voyage de Levante*, Livr. II. pag. 780. & Carol. Clus. de Exotic. Lib. II.

† See *Bellon. Observat.* Cap. 21.

exhibit the same Phenomēns, and produce the same Effects, in all kind of Trials, as the alkaline Salts procured from Mineral Waters. Now it is certain, that a calcarious Matter lodges in all Mineral Waters, whether hot or cold; and sometimes in such plenty, as to deposit a stony Crust about their Springs*. For it must not be imagined, that the calcarious Matter contained in Waters is owing entirely to such Stones as are usually burnt into Lime, by the Fire. There are whole Mountains in *England, Switzerland, Italy* and other Countries, of a white, chalky, or calcarious Earth, which impregnate the Waters that pass thro' them, and render them unwholesome; so as to produce strumous Swellings, and other Disorders. The greatest part also of our own Springs abound with such a calcarious Earth; as is manifest by dropping Oil of Tartar into the Water: whence thus it turns milky, and lets fall a white Sediment to the Bottom.

13. The alkaline Salt contain'd in these Mineral Waters, is either volatile or fixed. By volatile Salts we do not here understand such as are urinous, and extracted from animal Substances, by the Fire; but such as are of a changeable Nature, and easily dissipated by Heat. A Salt of this kind is found in most brisk, and cold Springs, which make a Conflict with Acids; but lose all their saline Taste upon being heated or boiled; and leave little or no alkaline Salt, but much calcarious Earth, upon a total Evaporation. There are however several cold medicinal Waters that yield a fixed alkaline Salt upon
Eva-

* The Existence of this calcarious Matter in Waters, is rendered evident by Dr. Lister, in his Examination of the Mineral Waters of *England*. See his first *Exercitatio* on the Subject.

Evaporation ; and most of the hot Springs afford it in plenty. If we examine into the Reasons of this Difference, it appears to proceed hence, that when the sulphureous Marcasites are violently heated, they exhale a large quantity, not only of volatile, subtile Spirit, but also one that is more fixed ; which joining itself to the calcarious Earth, strongly connects therewith into a fixed Salt. But when the Marcasites are heated in a less degree, they afford only a subtile Vapour ; which entering the Waters, associates itself more closely with their calcarious Earth ; and thence produces a finer or more delicate Salt, which by heat is easily separated and thrown off into the Air.

14. And nearly in the same manner is produced that subtile Vitriol wherewith certain Mineral Waters are impregnated. For every one knows, that green Vitriol is produced by the mixture of an acid, sulphureous Spirit, with an irony Substance. But 'tis manifest, that most Mineral Waters contain a quantity of irony Matter : when, therefore, the subtile, acid, sulphureous Exhalations, in rising upwards, meet with the irony Particles dispersed in the Waters, they unite themselves thereto ; and thus produce a vitriolic Principle, of a Texture less strong, proportionably, as the Union is less intimate. And the Connexion cannot possibly be strong ; because the sulphureous Vapours are so extremely fine and subtile, as to take little hold : beside, they cleave only to the finer irony Particles, which are separated from one another by the Interposition of the mere Water ; whence a close Contact is prevented, and the vitriolic Principle thus rendered easily alterable, and easily separable from the irony Particles.

*Origin of
the vitri-
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cles. And hence appears the Reason why, upon heating such cold Mineral Waters, they immediately lose all their pungent Taste, and Faculty of turning inky with Galls. But for a fixed vitriolic Salt, capable of enduring the Fire; no such thing is to be found in Mineral Waters.

*An alkaline
and vitri-
olic Prin-
ciple at
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15. It will seem strange to many, that the hot Springs which contain an alkaline Salt, should likewise contain any thing vitriolic: as imagining that all Alkalies destroy the Texture of Vitriol; so that they cannot both subsist in one Subject. But this Difficulty is easily solved: for daily Experience shews, that alkaline and vitriolic Salts may subsist together. We have an eminent Instance hereof in nearly all the cold medicinal Springs; which manifest a vitriolic Principle, both to the Taste, and by the Colour they strike with Galls: and yet make a considerable Effervescence with Acids; which shews their alkaline Nature. Reason also confirms the Possibility of the thing; for the Mineral Spirit lodged in the Waters, may at once join one part of itself with the alkaline Earth, and so produce an alkaline Salt; and unite its other Part with the irony Earth, and thus produce a subtile, volatile Vitriol. But the case is quite different when a Solution of Vitriol is added to a Liquor already impregnated with an alkaline Salt, or when an alkaline Liquor is dropt into a vitriolic Water; because they both by this means make an immediate Conflict, and so begin to destroy each other. Whence, according to the Difference, Time, and Order observed in the Mixture, there must necessarily ensue a different Effect. And thus we hope to have sufficiently proved the Agreement and Correspondence betwixt the Principles of hot and cold Mineral Waters.

16. We come now to the other part of our Design, viz. to shew the remarkable Similitude, and Correspondence, which these hot and cold Waters have in their Virtues and Operations. And this would be an easy Task, if Arguments *a priori* were a sufficient Proof: For, where the Principles of Action, and the Ingredients are alike, they must needs produce the same Effects: But both the hot and cold Medicinal Springs contain a highly penetrating, mineral Spirit, a volatile and a fixed Alkali, &c. and therefore their Virtues and Effects should be correspondent.

Correspondence in the Virtues of hot and cold Waters.

17. But to leave this kind of arguing as less certain, we proceed to Experience and constant Observation. And first, as the fundamental Indications, whereon the whole Theory and Practice of Medicine depends, regard either the opening of Obstructions, correcting the peccant Matters, strengthening the Fibres, and, as occasion requires, discharging what is useless out of the Body; so both the hot and cold medicinal Waters admirably answer these Intentions. For, by means of their elastic, penetrating Spirit, and alkaline Salt, they dissolve and wash away the stagnant Humours in the Canals, take off the Sharpness of the Juices, and break the Coagulations and Viscidity of the Blood. They likewise, by the quantity of mere Water they contain, dilute, prepare and correct the crude and ill-cooked Juices, dissolve their Salts, and blunt their Force. By means of their subtile vitriolic Principle, and ætherial Spirit, they restore a due Tone and Spring to the weakened Solids; and thus nobly promote the Business of Circulation. Lastly, they forward all kinds of Excretions, open the Out-lets, discharge the offending Humours, and throw what is superfluous out of the Habit, either by Vomit, Stool, Urine, Sweat
or

or Perspiration : and all this in so easy and gentle a manner, as cannot be expected from any other Remedy.

18. To touch upon a few Particulars ; these Waters are appropriated to Diseases of the Stomach. Thus they excellently cure Distempers of that Part, quench Thirst, restore a lost Appetite, remove Weight at the Stomach ; wash away the viscid Juices thereof, check an immoderate Appetite, and cure morning Retchings and Vomitings. Both the hot and cold Wells remove Obstructions in the Mesentery, Liver, Spleen and biliary Ducts ; rectify an ill Habit of Body ; cure the Scurvy, Jaundice, Melancholy, stubborn quartan Agues, and other Intermittents ; especially such as were stopt too soon ; or whilst the Cause still remain'd behind, in the Body.

19. They are both excellent in curing Diseases of the Lungs ; as the moist Asthma, &c. nor are they in the least prejudicial to consumptive Persons ; especially where the Disease arises from an Obstruction of the *Viscera* ; and for this purpose in particular, Dr. Morton earnestly recommends the *Islington* Wells, the Virtue and Efficacy whereof he experienced both in himself and others *. We omit, for brevity's sake, the great Correspondence between hot and cold Waters in stopping large Bleedings, too great Fluxes of the Hæmorrhoids, or Meneses, and restoring those natural Fluxes when obstructed ; and in curing various Diseases of the Bladder and urinous Passages, the Gout, Rheumatism, Cathars, Defluxious, and other internal Disorders.

20. There is likewise a great Affinity in the external Use of cold and hot mineral Springs ; for both of them, in the way of Bath, dissolve hard

* See *Morton*. Phthisiolog. Lib. II. Cap. 2.

hard Tumours, open the Bores of the Skin, confirm and strengthen the nervous and muscular Parts, weaken'd by a Defluxion of Humours, &c. On the contrary, they relax such Parts as are grown stiff and rigid by spasmodic Contractions; and thence become serviceable in the Palsy, Contractions of the Limbs and Fixedness of the Joints; as also where the Parts are swelled or full of Pain. They both likewise prove eminently serviceable in all Foulness and Deformities of the Skin; drying up Ulcers, Blotches, and Breakings out on the Body; and curing even the Leprosy it self.

21. And as both the cold and hot Waters have these extraordinary Virtues; they agree no less in the Mischiefs they produce, when imprudently used. Thus the drinking of neither is safe, where the *Viscera* are hard and schirrous; where the Humours are extravasated, or lodged in the Cavities of the Head, Throat or Abdomen; and where the Stomach, Lungs, Mesentery, and Intestines are ulcerated, or impostumated. Their Use is also prejudicial in the Apoplexy, Falling-Sickness, inveterate Pain on one side of the Head; or where the Memory, or the external and internal Senses are impaired. Again, these Waters do hurt in the convulsive Asthma, a Polypus in the Heart, a Dropsy in the Breast, in Consumptions, cancerous eating Ulcers, proceeding from a venereal Cause, and in an involuntary Efflux of the *Semen*. Lastly, they must be cautiously used in all kinds of Inflammations, both of the external and internal Parts; unless where the Disease seems abated, or going off.

22. And tho' there hence appears a great Conformity betwixt the cold and hot medicinal Springs, yet there are several Differences to be allowed

*Wherein
the hot and
cold Springs
differ from
each other.*

allowed therein ; tho' such as do not destroy the general Correspondence and Harmony between them. Thus they evidently differ in respect of Cold and Heat ; and accordingly are to be well distinguished, with regard to the Disease and Constitution of the Patient. They differ again in this, that the cold Waters contain more of a volatile, and the hot more of a fixed Salt. So likewise, the cold Waters hold a more copious subtile Vitriol, than the hot ; and some few of the hot ones likewise contain a true Brimstone, in substance ; as particularly those of *Aix la Chapelle*. Lastly, there is this considerable Difference between them, that the cold Waters are always more abundant in the subtile, mineral Spirit ; which is easily dissipated in the hot ones.

*And from
themselves.*

23. There is also this remarkable Difference between the cold Mineral Waters themselves, that some of them are impregnated with more mineral Spirit than others ; as the *Pyrmont* Waters in particular. And some of them, besides an alkaline Salt, contain one that is neutral ; and some again no more than a neutral Salt, as the *Epsom* Waters and others. Some of them likewise contain much irony Matter, as those of *Pyrmont* ; and others abundantly less. In general, both the hot and cold Springs differ from those of either kind in respect of the mere Water, which contains the other Ingredients. Thus several of them hold a crude and ponderous Water ; others a hard and light one ; and others again, such as is soft and light. And hence it is that some of them are better suited than others to the Cure of particular Distempers.

*Doctrine of
the preced-
ing Disco-
veries.*

24. These Differences in Mineral Waters may direct us to form several Axioms, of considerable Use in the Art of Medicine ; for Instance the following. (1.) Persons of slender Vessels,

Vessels, tender Fibres, weak Nerves, and subject to spasmodic Contractions, should rather use the hot Springs than the cold. (2.) Persons of robust Habits, and strong Fibres, but labouring under Obstructions and stubborn Disorders, can better bear the Use both of such hot and cold Waters as operate violently, and have a greater specific Gravity. (3.) Such hot Springs as afford a hard and ponderous Water, repel strongly, so as easily to cause Thirst, Fevers, Head-ach, and strike external Disorders inwards: whence they are to be used with the greatest Caution. (4.) Those Springs that afford a soft, light and mild Water, are best fitted to supple and relax stiff Limbs, and such Parts of the Body as are grown rigid; and at the same time to open the excretory Ducts that lead outwards, and promote a Discharge thereat.

25. Lastly, this Difference is to be observed in the Nature and Use of the cold mineral Springs; that they have a more noble and excellent Property than the hot ones, by reason of the greater quantity of Mineral Spirit they contain. Their Water is also lighter than that of the hot Springs; which, on account of their Heat, easily dissolve many impure and gross Matters in their passage thro' the Earth. And yet it is certain, from Experience, that the cold Waters prove more mischievous than the hot. The reason whereof seems wholly owing to their Coldness; which is very pernicious to some Constitutions, when it comes to the inner Parts. That the drinking of cold common Water may prove dangerous both to Men and other Animals, is a known Observation; but especially to drink it violently cold, when the Body is heated with Exercise; or when the Person has a strait and narrow Chest, a relaxed Stomach, weak Intestines, and feeble

*Cold
Springs
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to the hot.*

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Nerves; which is generally the Case of old Men and Children. The Risk of thus drinking very cold Water is greater if the Stomach be empty: for by this means the cold Water comes into an immediate Contact with the more sensible nervous Coats of the Stomach; and may prove highly pernicious thereto. Whence it is my constant Advice, that the cold kind of Mineral Waters, drank in the Morning, should be a little warmed; but so as not to lose the fine Mineral Spirit. And by this means such Waters are not only rendered safe, but much more effectual in the Cure of Diseases.

S E C T. V.

WATER considered as an UNIVERSAL REMEDY.

*Difficulty
of disco-
vering an
universal
Remedy.*

1. **H**OW much an universal Remedy has been the Desire of all Nations and Ages, is well known to those who are conversant in the History of Medicine: and if any Physician could be so happy as to find it, what Reward were equal to the Discovery? But as we are hitherto possessed of no one Medicine, that will certainly, and at all times, cure any one Distemper; there are but little hopes of discovering a single Remedy for all the various Diseases with which Mankind is afflicted: especially as Diseases happen in Bodies of different Constitutions; and proceed from different, and often contrary Causes.

*Water ap-
proaches
nearest to
an univer-
sal Remedy.*

2. But if there be, in Nature, any Remedy deserving the Name of universal, 'tis, in my Opinion, no other than common Water: the Use whereof

whereof is so necessary, that Life and Health cannot subsist without it. And by its Assistance all kinds of Distempers are frequently cured; and the Body preserved sound, or defended from Corruption, that utter Enemy to Life.

3. To lay the better Foundation for shewing, by solid Arguments, that pure, simple Water is a kind of universal Remedy, we shall first observe, from the necessary Destructibility of the Body, what Diseases are in themselves incurable. As to the natural Necessity of Death, 'tis evident, that the Duration of the human Body, and its Preservation from Corruption, entirely depend upon the continued and uninterrupted Circulation of the Blood and Juices: for so long as this Motion remains entire, so long the Body is said to be alive; but as this Motion gradually ceases, Death gradually comes on. This Motion therefore is the only thing that preserves the Body from Corruption; by preventing Rest, the Cause and Foundation of all Putrefaction, in that heterogeneous Fluid whereof all the Parts of an animal Body are form'd.

4. The human Body would certainly last for ever, if the Circulation of the Blood could be therein for ever continued: but the Condition of human Nature allows not of this; because the Circulation of the Fluids, whereon Life depends, is performed by means of Instruments, which consist of the elastic Fibres of Muscles, that have a reciprocal Dilatation and Contraction, and are Vessels of greater and less Capacity; whence if the Spring or Force of the Fibres be so weakened as no longer to give the requisite proportionable Motion to the Juices, so that they do not freely and readily circulate in the finest Canals, there must, of necessity, ensue Stagnations and

Corruptions of these Juices, in the fine capillary Vessels, and thus produce Diseases and Death.

5. And as in all Machines, the Springs, and moving Powers, by reason of a Change in the Matter whereof they consist, at length become weak and useles; in the same manner does the Body itself; the Fibres thereof, whereon the Motion wholly depends, growing hard, solid and dry with Years. And thus they not only become more indisposed to Motion, but also the fine Canals of the Body are rendered straiter; insomuch that the Fluids have not their free and equable Motion thro' them. We find a Proof of this in the Flesh of old Animals; which, by reason of its Hardness and Solidity, requires a greater Heat and longer Boiling, before it will grow soft and tender. And hence 'tis manifest, that if the Fibres and Vessels of the Body were to continue in the same State, and Degree of Mobility, and the Pores in the same Degree of Openness; Life might thus be prolonged for ever, unless some violent external Cause should prevent it. That this is, in the Nature of the thing, any way possible to effect by Medicines, Regimen and Diet, will seem inconceivable to those who are unacquainted with the Powers and Laws of natural Bodies. 'Tis however certain, that most Men do not arrive at that Period of Life, which the Body, by its natural Frame and Make, was intended for; and this thro' a want of knowing or observing the Rules of conducting the Body, thro' all its Stages. And hence it is, that the greatest part of Mankind, thro' Intemperance in Diet, Ignorance in the Art of governing the Passions, and a Neglect of those things which are prejudicial or serviceable to the Body, certainly shorten their Lives, and procure Diseases to themselves *.

9.

* Whosoever desires to see this whole Affair deduced, may consult the Lord Bacon's *History of Life and Death*.

6. This Doctrine, of the internal and natural Cause of the Destruction of the Body, will lead us into the true Nature of incurable Diseases. For as by the Laws of Motion, and the Laws of Reason, there must ever be a Correspondence betwixt the Agent and the Patient, for the Production of an Effect; if there shall at any time happen inveterate and stubborn Obstructions in the Vessels of the Body; large Discharges of Humours in the Cavities thereof, and thence actual Putrefactions; what Remedies can the Art of Medicine here supply? What can Physick do in deep-seated Inflammations, that cause actual Mortifications in the noble and necessary Parts? Lastly, what Cure can we rationally hope for in violent Convulsions, and extreme Disorders of the nervous System? If a Physician could be serviceable in these Cases, he might seem born for the Happiness of Mankind.

7. Let us next enquire, whether there be in Nature any infallible Remedy for the Cure of any Distemper. Every one knows that Specifics are highly recommended for the Cure of particular Diseases: thus the Bark is accounted a safe and certain Remedy for intermitting Fevers; Mercury is highly praised for its Efficacy in venereal Cases; Opium is said to ease all kinds of Pain; Steel is esteemed the principal Cure for hypochondriacal Persons; Castor is prescribed as effectual in nervous Disorders; and Nitre for extinguishing the burning Heat of Fevers. But to say the truth, tho' these Remedies have their Use; yet he who is versed in Practice, will assuredly find, that such Medicines are by no means equal to the Diseases; in which they are recommended. Nearly all Distempers may proceed from different and often quite contrary Causes; they often skulk under

No infallible Remedy for anyone Disease.

different Symptoms ; and Bodies are of different Dispositions and Constitutions ; so that the same Remedies shall often act differently upon them, and sometimes produce opposite Effects. And certainly it requires to be well observed, that Remedies do not act upon the Body according to their own Nature ; but according to the Manner wherein the Body receives them ; or, in other words, that their Virtues depend upon a mechanical, and reciprocal Action and Re-action, betwixt the Body and the Medicine. Whence appears the Absurdity of their Practice, who apply but one and the same Remedy, in the same manner, for the Cure of a Disease in different Constitutions ; without regard to the Cause and Circumstances of the Case : which is an infallible Mark of a Physician not to be trusted.

How Water is an universal Remedy.

8. Having thus prepared the way, we come now to explain in what sense we take Water for an universal Medicine. We assert, that “ Water is a Remedy suited to all Persons, at all times ; that there is no better Preservative from Distempers ; that it is assuredly serviceable, both in acute and chronic Diseases ; and lastly, that its Use answers to all Indications, both of Preservation and of Cure.”

The Difference of Waters in regard of Spirituousness.

9. But as there is a great Difference in Waters, a principal Regard must be had to discover such as are best fitted for this medicinal use : since it is certain, that the Nature and Properties of particular Waters differ so far as to be easily distinguished, even by the Taste ; especially by such as are accustomed to drink Water. But the best Way of distinguishing them is by chemical Trials, Weight, and mixing them with different Substances. It must not be imagined that Water is an homogeneous Fluid ; there are numerous Experiments that manifest it to be a Mixture of different Parts. Thus all Waters contain an aërial

aërial or ætherial Principle, whereon their elastic Property seems entirely to depend. For all Waters are more or less expansive and contractive, as they contain more or less Æther. This evidently appears in the Water-Thermometer; where the included Liquor possesses a greater or less Space, according to the greater or less degree of Heat it sustains. For 'tis the Nature of all Liquors to admit a greater Quantity of ætherial Fluid when they are heated; and to reject it when they are cooled; as we know by particular Experiments, made in a very severe Winter. The Quantity of Air or Æther residing in Water cannot, perhaps, be better determined, than by means of the Air-Pump; for the more subtile Waters when included in an exhausted Receiver, throw up numerous Bubbles; and if somewhat heated, these Bubbles flow over the containing Glass: as, on the contrary, those which are grosser and more ponderous, afford fewer Bubbles *in Vacuo*.

10. Waters also appear to consist of a lighter and a heavier Part; and the former, as being more moveable, easily rises first in Distillation; whilst the heavier and grosser Particles require a greater degree of Heat to bring them over. Whence 'tis observable, that Waters lose their more subtile Parts in boiling, and leave the cruder and less useful ones behind; as is known to all those who are curious in the making of Coffee: for if the ground Berries are put into Water, that has long been boiled; the Liquor so made becomes less quick, and pleasant to the Taste. It has also been observed, that some Waters rise much faster than others in Distillation. Waters also differ extremely in their Gravity, as appears by the Water-Poise; those which abound with Earth and Salts causing the Instrument to rise higher than such as are pure. But Distillation

*To discover
the Levity
and Purity
of Waters.*

is one of the best ways of discovering the Purity of Waters; as not only rendering the Quantity, but also the Quality of the Contents evident to the Senses. 'Tis surprizing to see what a large Mass of earthy or stony Matter remains upon the Distillation of some Waters. I once distilled two Quarts of Spring-Water, in a Glass-body, to Dryness; repeating the Operation ten times, in the same Vessel: and by this means obtain'd a hard stony Crust at the bottom, as thick as the Back of a Knife. Most Waters contain a chalky Earth, some an Oker, others a stony Matter, and others again a Proportion of common Salt. But the true way of examining whether Waters are impure, or contain any foreign Matters, is by the means of chemical Experiments; two whereof I have singled out for my own use, and recommend them to others, as exactly discovering the Purity or Impurity of Waters. The first is, by dropping Oil of Tartar into them; and the second, a Solution of Silver in Aqua fortis*. If the Waters are pure, such as Rain-Water, Water distilled, and some sorts of Spring-Water, they manifest no Alteration upon mixing with these Liquors; but if impure and gross, they turn milky with Oil of Tartar; especially if they abound with a chalky Earth. And the Solution of Silver turns impure Waters thick, grey-coloured, and, if they participate of Iron, almost red.

II. The Effect of Waters also manifests their Nature, Subtilty and Purity: thus those that are light and soft serve best for mollifying the Bones of Animals; and the boiling of Sea-Fish. The Whitsters and Bleachers find a remarkable difference in Waters; the softer and fatter sorts thereof

* This was Mr. Boyle's Secret for discovering the smallest Proportion of Sea-Salt contained in any Water.

thereof serving better to wash and blanch, than such as are ponderous, hard, and take Soap with difficulty. The Bakers find, that the more soft and subtile Waters make their Bread rise best. The Gardeners observe, that such Waters as are light, subtile and spirituous, are much better to water their Beds with, than such as are hard. The Masons, Makers of Terras, and Figures in Plaster of *Paris*, find hard Water the best for their purpose; and can scarce work with such as is soft; so as to give their Matter its due Strength and Firmness. The Chemists find a great Difference in Waters; those of Rain being best suited to wash and edulcorate their Magisteries and metalline Powders; as the Calx of Gold or Silver, the *Caput Mortuum* of Vitriol, &c. as readily drinking in the Salts, that hard Spring-Waters will scarce touch. We daily observe, in the domestic Operations of brewing, washing, the making of Tea, &c. that the more subtile and soft River-Waters are better for these Purposes than Spring-Water.

12. But for medicinal Purposes we prefer Rain-Water, as what is naturally distilled by the Sun, and thus rendered subtile and fitter for Solutions, Infusions, Extractions, and all internal Uses. Only this Water being mixed with various mineral, vegetable and animal Exhalations, is thence rendered easily corruptible, if exposed to the free Air, or suffered to stand long in Vessels of Wood. The Rain that falls in the Month of *March*, is more durable; as not then receiving so many Effluvia. The better to fit this Water for medicinal Use, 'tis proper to keep it in earthen Vessels close stopt down. And thus if it be collected, not in Cities and Towns, as it runs from the Spouts of Houses; but in the open

Rain-Water best fitted for medicinal Use.

open Fields; it may be kept sound and serviceable for several Years.

*River-
Water,
how fitted
for medi-
cal Use.*

13. Next to Rain-Water, in point of Goodness, comes that of Rivers. But as Rivers proceed from the Springs situated in high and mountainous Places; and as Rains increase these Springs, which running over vast Tracts of Land, drink up many different Matters from the Earth; hence Rivers become more turbid and impure, the larger Tracts of Land they wash in their Course. Add to this, that they take up numerous heterogeneous Parts from the Bottom they run upon; whence there often arises a considerable difference betwixt Rain and River-Water. Lastly, Rivers, by being perpetually exposed to the free Air, and the Action of the Sun, have their more subtile Parts exhaled and raised into the Atmosphere, so as to supply the Matter of Clouds and Rain.

14. There is likewise a great Difference between the Waters of Rivers: for those that have a swift Course, or run violently down from the Mountains, where they rise, into the lower Plains, are very different from those where the Course is slack and gentle; and therefore generally rise in lower Places. Thus the rapid Rivers usually afford a light and subtile Water, not greatly subject to Corruption; tho' somewhat improper for the feeding and nourishing of Fish: because the Rapidity of their Motion prevents the Spawn of the Fish from clinging to their Banks; so as to be there animated by the Heat of the Sun. But tho' these Rivers of swift Course do not greatly abound with Fish; yet those they produce are well tasted and excellent. Thus the Waters of the *Rhine* and the *Rhone*, which rise from the highest Mountains of the *Grisons* Country, are found to be much lighter than the Waters of other Rivers.

And

And 'tis remarkable, that the Ships coming out of the River *Maine* into the *Rhine*, draw much more Water in the latter. And hence the Waters of the *Rhine* and the *Rhone* appear, upon hydrostatical Examination, nearly to approach the Lightness of Rain Water : and as both these Rivers are very rapid, their Waters are thence rendered less corruptible ; and are therefore allowed, for internal medicinal Use, to excel the Waters of all other Rivers. Thus we are assured from a good Writer upon the Water of the *Rhone*, that " if put into large earthen Jars, and kept in Wine-Vaults, so as there to deposite its Sediment for " some Weeks or Months before 'tis drank, it " thus becomes pure and excellent ; and will when " rack'd off fine, keep many Years, or even an " Age, without corrupting *."

15. The Rivers that flow gently, differ from the former, not only on account of the immense Quantities of Fish they breed ; but also because they generally run on fat and clayish Bottoms, that afford proper Bedding and Nutriment to Fish : whence such Rivers are not so clear and crystalline as those of a rapid Course. But then such Waters are of a softer Nature ; and serve for the Purposes of Washing, Fulling, Scouring, &c. without any considerable addition of Soap. From hence it may easily appear, that Rivers are not all alike, or equally fit for medicinal Use. Those to be chose for this purpose are clear, and light, do not easily corrupt, and receive no Alteration upon the Addition of Oil of Tartar, or any metalline Solution. It must be constantly observed, that Rivers of a rapid Course, are uni-

* Jacob. Spon, in Observation. circa Aquam Rhodan. in Aët. Erudit. An. 1683. pag. 519.

universally more wholesome than those which run slow and gentle.

*Spring-
Waters,
how fitted
for medi-
cal Use.*

16. Spring-Waters also are sometimes observed to differ in their Virtues. For tho' these Waters owe their Origin to Rain; yet, according to the different Nature of the Soil, and earthy Matters they meet with or imbibe, they receive a different Nature and Disposition: whence we seldom find Springs of a perfectly pure and light Water. The greatest part of them leave a copious earthy Substance upon Distillation. There are but few that do not turn thick with metalline Solutions, or alkaline Salts. Some of them contain common Salt; and others a subtile, volatile Vitriol. If they hold common Salt; Oil of Tartar, or a Solution of Silver will discover it, by turning milky therewith: if they contain a vitriolic Principle, the Infusion of Galls, or Balaustian Flowers, will shew it, by turning black therewith. There are others again, that contain somewhat of Iron, and thence have a styptic Taste; and let fall an Oker upon standing. 'Tis therefore the Business of Art and Industry, out of so large a number of Springs, wherewith Nature supplies us, to discover the wholesomest; which are known by their Lightness, Transparency, Purity, Durability, and the Trials above-mentioned. This Difference, in Spring-Waters, must also be observed, that some are soft, and others hard; the latter whereof are the most durable and indisposed to freeze: whereas the former easier turn to Ice. They are both of them wholesome and medicinal; if properly suited to the Disease and Constitution.

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17. Having thus shewn which Waters are best fitted for medicinal Use, and how they are to be distinguished and examined, we proceed to prove the Excellence and universal Virtue of pure Water.

Water. Our first Position is, "That pure and light Waters are agreeable to the different Natures and Constitutions of all Men." For since the Circulation of the Fluids, thro' the Canals and finest Vessels, is what preserves and secures the Body from Corruption, and keeps the Blood and Juices in a thin moveable State; Water must needs be appropriated to the Continuance of Life. The Fluids of the Body serving to Nutrition and the vital Offices, and whereof the Solids also are composed, actually consist both of Solids and Liquids. That there are solid Parts contained in the Blood, is evident upon drying it; and that these Parts are of different Natures, some saline, others unctuous; some mucilaginous, and others earthy, appears to the Senses, by the inflammable Property they have upon Evaporation, and other chemical Experiments. In short, the Blood and animal Juices are a number of heterogeneous Parts; which prove extremely corruptible, in a State of Warmth, Rest and Moisture. To prevent the Fluids from thus corrupting, and consequently infecting all the other Parts of the Body, it is necessary they should never stagnate; otherwise Corruption would immediately ensue. And hence these subtle, solid Particles, both unctuous and earthy, should not only be kept in perpetual Motion, among themselves; but also circulate in a progressive Motion, thro' the finest Tubes of the Body; that the solid Parts of the Blood may be divided into extremely fine Globules, by the Motion of Attrition, or Action and Reaction between the Juices and the fibrous Parts. Whence appears the necessity of an ærial, ætherial, fluid, and elastic Principle, to be mix'd along with a large Quantity of an aqueous Fluid; that is, the Necessity of pure Water, to secure this indispensable

sable Effect. And hence it is, that upon examining the Blood, taken from a Person in Health, we find at least two parts of a fluid, to one of a dry and solid Matter: for I have frequently observed twelve Ounces of Blood to contain eight Ounces of a liquid, and four of a solid Substance. Again, that the Blood contains a large Quantity of a subtile, ærial, and ætherial Principle, manifestly appears from its bubbling in *Vacuo*, so as to run over the Edges of a cylindrical Glass, whereof it at first possess'd only one half. From the whole we infer, that nothing is more wholesome, nothing better fitted, or more necessary to preserve Life than Water; which is agreeable to the Nature of the human Body, and without which it cannot subsist, nor Life be long preserved.

That Water is the best Preservative of Health.

18. Our next Position is, "That no Remedy can more effectually secure Health, and prevent Diseases than pure Water." If we strictly enquire into the Cause of Health, we shall find it to be an equable and free Circulation of the Juices thro' all the Canals of the Body; even the finest that lead to the excretory Ducts. For by this means it is, that what proves serviceable and fit for Nutrition, remains within, separated for Use by the proper Strainers; and what would either prove useless, corruptible, and inconvenient to the Body, is discharged. And here it deserves the utmost Attention, that the Excretions of the Body do not so directly, simply, and absolutely regard Life, as they indirectly regard Health, and the due Exercise of all the Functions and Offices; insomuch that Health, and Life it self, may be endangered, without any fault in the Excretions. Thus 'tis obvious that, from violent Passions of the Mind, extreme Pain, Inflammation of the Stomach, and the swallowing of

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of Poisons, the natural Functions of the Body are strangely disordered. Neither in the most obstinate chronical Diseases are the Excretions so much to be regarded, as the Obstructions of the glandular Parts, the Indurations, Corruptions and Sphacelations of the *Viscera*, and Extravations of the Humours. So likewise in acute Distempers, the inflammatory Disposition of the Blood is chiefly to be regarded. 'Tis therefore an equable Motion of the Blood and Juices that maintains Health, promotes the Excretion of unnecessary Matters, affords a convenient Nutrient to the solid Parts, and procures to the Nerves and Fibres that most subtile Fluid, by means whereof they feel and move. But whenever this free and equable Motion is obstructed, whether by an Over-charge of Humours, their too great Tenacity, or by Weakness in the Spring of the moving Fibres, an immediate Cause of Diseases arises; as from hence proceed Stagnations of the Juices in the larger and smaller Vessels, Obstructions in the excretory Ducts, and Indurations in the glandular Parts. These are soon followed by great Impurities of the Juices, causing Pains, spasmodic Disorders, and Putrefactions, which are the Bane of Health, and the direct opposite to Life. And thus are the true Causes of Diseases, especially the chronical kind, formed in the Body.

19. Every one who perceives the Justness of this Account, will readily grant that a proper Fluidity of the Blood is highly necessary to procure a free and equable Circulation; by means whereof the Vessels are kept always open, Obstructions prevented, Excretions secured, Stagnations and Impurities of the Juices hindered, and the Causes of Diseases cut off. And whether there be in Nature a better disposed Remedy,
for

for procuring this necessary Fluidity to the Blood, we leave to the Judgment of sober and experienced Physicians. To us it appears, that a pure and subtile Water exquisitely divides the solid and viscid Parts of the Blood and Juices, so as to prevent their coagulating, or coming too close together; at the same time that it drinks up the useless and recrementitious Matters of various Kinds, whether earthy, saline, or unctuous; and discharges them by the proper Outlets: consequently, for want of a due Moisture and Motion in the Body, numerous Diseases must necessarily arise.

20. And hence, we conceive, proceeds the Reason why the Drinkers of Water, provided it be pure and excellent, are more healthy and longer lived than such as drink Wine, or Malt-Liquors; and why it generally gives them a better Appetite, and renders them plump and fleshy. For certainly, Water is a most appropriated Menstruum to dissolve the Aliment, extract its Chyle, or nutrimental Part, and carry it thro' all the finest Canals of the Body. Besides this, it readily washes off and dissolves that tough viscous Slime, which lines the glandular Coats of the Stomach, and *Duodenum*; whereby the dissolving Juices of the Intestines, which Juices are the immediate Instruments of Digestion, may more plentifully mix with the Food, and perform their Office. There goes a common Opinion, that the drinking of Water is pernicious to those who eat Fruit; but this is a great Mistake: for in *Spain*, *Portugal* and *France*, Water is the common Drink; and yet these Nations freely eat Fruit all the Summer, without any Inconvenience. Again, those who drink Water are observed to have much sounder and whiter Teeth, than others: for Putrefaction and Corruption of the

the Teeth is caused by the Scurvy; a Disease prevented by the drinking of pure Water, which actually cleanses and washes the Blood, and discharges the Foulness thereof. Add to this, that the Drinkers of Water are much brisker, and more alert to all the Actions both of Mind and Body, than such as use Malt-Liquors; the greatest part whereof produces viscid and sluggish Juices, hardly capable of passing thro' the exquisitely fine Vessels of the Brain and Nerves: whence ensue Indolence and Weakness of the Body, and an Indisposition and Dullness of the Limbs, both to Sense and Motion. And as this plainly appears to be matter of Fact, 'tis the more surprising that the drinking of pure Water, which is remarkably conducive to the Preservation both of Life and Health, should be so perversely, and, as it were, unnaturally nauseated by the People of our Country; whilst 'tis as strongly coveted and admired in other Nations. Such Malt-Liquors as are thick, and highly nutrimental, lay the Foundations of many Disorders among the Inhabitants of Northern Countries; more particularly where the Use of Brandies, Spirits, and Strong-Waters prevails. It is certainly much better for all Persons of delicate Constitutions, and sedentary Lives, to accustom themselves to the drinking of the finest and purest Water, either alone, or mixed with Wine to render it more acceptable.

21. Having thus considered the singular Efficacy of Water, by way of Prevention; we come next to examine what it will perform in the Cure of Diseases. Physicians divide all Distempers into acute and chronical. Of the acute kind, the principal are Fevers; which from the Structure of the Body, and the Laws of Motion, appear to be an Increase of the Blood's Velocity and

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Force;

That Water is curative of Fevers.

Force; so as to distend both the fibrous and fluid Parts of the Body beyond their natural Size; this Increase of Motion having a Tendency either to overcome and discharge the Cause of the Disorder, or to destroy the Machine itself : whence there ensues either Recovery, Death, or a Depravation of some Parts of the Machine when the original Disease terminates in another. And thus Nature, which, tho' she is often her own best Physician, yet sometimes also produces Diseases and Death. But here we must by no means confound the rational Soul with Nature; which is a word we use to signify the Structure, Mechanism and Contrivance of the Body, acting with certain Powers, according to certain necessary and mechanical Laws, assign'd it by its Maker. A Physician therefore, in the present imperfect State of Medicine, can do no more than supply a proper Matter to this augmented Motion in continued Fevers, during the whole time they thus regularly continue; for they have their own natural Periods, that cannot hitherto be safely controlled by Art. This increased Motion and Distension, is attended with a great Heat, that violently dissipates the fluid Part of the Blood and Juices, so necessary to Life: whence the principal Intention is to supply this fluid Part, in proportion as it wastes. And as the Tendency of this increased Motion is to break thro' the Obstructions, that cause the Disorder; the Blood can by no means make its way, unless sufficiently thinned and diluted with a proper Fluid: but thus assisted, Heat and Inflammation may be allay'd, the stagnating Juices propell'd, and the offending Matter, that causes the Mischief, discharged. And Experience shews, that if Water be not the only thing, yet there is no better Remedy yet found for this kind of Fever, than

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a free and plentiful Use thereof. Whence *Hippocrates* and others highly recommend an aqueous Ptisan for this purpose. And accordingly, by this alone, with the assistance of Rest and temperate Warmth, the most violent Fevers have frequently been cured, without any other Medicine. All that the best Physicians can do in these Cases, is either to bleed at the beginning, when the Body is full, or to exhibit an Emetic, if the Distemper is seated in the first Passages; or to prescribe a Sudorific, in order to expel the Cause in the most expeditious manner: but after this, thro' the whole Course of the Distemper, they give nothing more than cooling, moistening and perspirative Remedies. The Caution required in the Use of Water for this Distemper is not to give it too cold, especially near the Crisis; or when there is reason to fear an Inflammation in the first Passages; or when the Body is stiff and rigid, and the external Parts parched and bound up: but to wait for the time when there appears a Disposition to sweat; at which time 'tis ever proper to give Water in a large quantity*.

22. Those called Chronical Diseases, generally arise from an Obstruction of the *Viscera* and glandulous Parts, or a Surcharge and Foulness of the Juices, with a Stagnation thereof in the larger Vessels; all which, according to the Rules both of Reason and Experience, are therefore to be removed in order to a Cure: But to procure this Effect, there is not a more serviceable Remedy than pure Water. How eminently serviceable the medicinal Waters, both of hot and cold Springs, are, for this purpose, is a thing manifest by Experience. But the major part of

Water curative of Chronical Diseases.

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* This is agreeable to the Advice of the best Physicians, and particularly insisted on by *Lommius*, in his Discourse of Fevers.

their Efficacy in this respect, is beyond all dispute owing to the Quantity of pure elementary Water they contain: for it were insignificant to exhibit in these Distempers the mineral, volatile Spirit, and the Salt which such Waters contain, without that purely aqueous Part. And accordingly, there are numerous Instances where pure and light Water, without containing any Mineral Ingredients, has proved of extraordinary Efficacy in the Cure of chronical Diseases. The Effect therefore can possibly be ascribed to nothing else, but to the pure Water. Of this kind there are numerous Springs in *Germany*; the Waters whereof being pure and subtile, tho' plentifully abounding with Air and *Æther*, prove curative of most chronical Distempers; particularly the Stone, the Gout, the Rheumatism, the Scurvey, Weakness in the Limbs, &c. and by procuring the requisite Fluidity to the Humours, they remedy Suppressions of the *Hæmorrhoids* and *Menses*.

23. As there is, therefore, sufficient Reason to persuade us that the Wholesomeness of many Springs depends upon the Goodness of their Waters, it follows, that where other pure Waters are procurable, these likewise will have the same Effects. And this also is confirmed by Experience, as may appear from the Testimonies of *Riverius**, *Celsus*†, *Ballonius*‖, *Sylvaticus*‡, *Martianus***, *Rondeletius*††, *Avicenna*‖‖, and others; who shew that the drinking of Water has

cured

* *River. Oper. Lib. 4. Cap. 24.*

† *Cels. Lib. 1. Cap. 15.*

‖ *Ballon. Lib. 1. Epidem. pag. 106.*

‡ *Sylvatic. Cap. 1. observat. 1.*

** *Martian. in Hippocrat.*

†† *Rondelet. Prax. pag. 611.*

‖‖ *Avicen. Lib. 1. Sect. 2. Cap. 16. pag. 102.*

cured Obstructions of the *Menses*, the Head-ach, Ophthalmia's, Colds, Rheums, Inflammations, the Gout, the Colick, &c. being used either cold or warm, as the Stomach can bear, or the weak State of the Nerves requires.

24. Of what singular Efficacy pure hot Water is, both by way of Preservative, and Cure, appears from the Nature and Use of Tea-drinking. For 'tis certainly a Mistake to attribute all the good Effects of Tea to the Leaves of the Plant. The principal Virtue of this Infusion is doubtless owing to the Quantity of the pure hot Water employed in the making; whilst the Herb, by its Astringency, prevents the Fibres of the Body from being too much relaxed and weakened. Therefore, as numerous Diseases are attended with a strong Contraction of the Fibres, all Physicians who are well versed in Practice will be cautious of indulging too free an Use of this astringent Ingredient *, in such Cases. And to speak a serviceable Truth, we have in our own Country many Plants, whose Virtues far exceed those of the *Indian Tea*. Indeed choice should be made of these Plants, for medicinal Use, according to the Difference of Distempers. Thus, for Example, in Diseases of the Breast, the Paul's Betony is proper; common Betony in Disorders of the Nerves; Baulm and Peny-royal in Diseases of the *Uterus*; Ground-Ivy in Ulcers of the Kidneys; Buck-Bean in the Scurvey, &c. being severally made into Tea, with the purest Water, and drank hot. Again, common Camomile

*Efficacy of
Water in
Tea.*

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* That Tea is an astringent or styptic Plant, appears by several Experiments, as particularly because, like Oak-Bark, Balauſtian Flowers, and other astringent Vegetables, it turns inky with a Solution of Iron; or the Chalybeate Waters.

may be advantageously used, in the way of Tea, against the Colick; Parsly in the Stone; the *Ranunculus* in the moist Asthma, &c. * But in all Teas 'tis a Caution of moment that the Water designed for the Infusion, be not long boiled; but immediately poured upon the Plant, as soon as it simmers, in order to prevent the Loss of its more subtile Part.

That Water agrees with all Constitutions, and answers all Indications.

25. It remains that we shew Water to be an universal Remedy, as it agrees not only with all Constitutions, but in all the Indications of Distempers. And first, the drinking of Water is serviceable in every Complexion. In the sanguine, and those of a soft Habit of Body, who have but few of the finest kind of Vessels, it causes the Blood and Juices to circulate freely: which in this Constitution would otherwise flow but slowly, and so be apt to generate Obstructions in the *Viscera*. In bilious Habits, where the Humours are in brisk Motion, it allays the excessive Heat that would otherwise evaporate the unctuous Parts of the Blood, thro' the widened Tubes and Pores of the Body. It likewise proves extremely serviceable, by diluting and thinning the Viscidity of the Blood and Juices, in Persons of melancholy and phlegmatic Constitutions. Again, Water proves agreeable to Persons of all Ages. Children are frequently subject to violent Disorders from the Viscidity and Acrimony of the Milk they feed on; in which Case, besides Absorbents, diluting aqueous Remedies are of great service. In Youth, the Surcharge and Thickness of the nutritious Humours produce various Diseases; such as Colds, and Eruptions of the Skin; which are excellently remedied by the Use of diluting Liquors. And the

* Rosemary Tea is by many recommended as excellent in nervous Diseases.

the same holds true of the Diseases of grown Persons, and Persons in Years; in all which the drinking of Water is serviceable. For Men of full growth are very subject to Inflammations and Fevers; and old Men to such Disorders as proceed from Stoppages and Obstructions; in which Circumstances there can nothing be given more proper than the finest Water, either hot or cold. We find by daily Experience, what severe Disorders are occasioned by Irregularity in the menstrual and hæmorrhoidal Flux; to reduce which to their natural Periods, and preserve them in proper Course, I am convinced, from practical Observations, that nothing is more effectual than diluting aqueous Remedies.

26. 'Tis well known, that a Fulness of Blood and Juices brings on many Distempers; but to prevent this Fulness, the most appropriated thing is hot Water, made into an Infusion with Herbs; which thus by dissolving the glutinous Humours, prevents the Mass of Blood from increasing too fast. A free Use of Water is no less serviceable in purifying foul Juices; as it readily washes off their impure, saline and droffy Parts, thro' all the excretory Passages of the Body. Besides this, the drinking of Water promotes all the Evacuations, preserves the Belly soluble, keeps the urinary Passages open, washes and cleanses the same from the Adhesion of gravelly or stony Matter, and powerfully promotes that most healthy of all Discharges, insensible Perspiration. Lastly, Water is an effectual Vehicle of all other Remedies. Thus, Antiscorbutics, and vegetable Medicines appropriated to cleanse the Blood, prove of little service in correcting the Depravities of the Humours, unless by the assistance of Water their Virtue be carried into the Juices and remote Parts of the Body, in the

Form of Decoction or Infusion. To sum up all, in whatever Cases there is a Necessity either for altering, evacuating, opening, or resolving, Water is at all times the best of Remedies.

27. As Water is thus extensively useful, it may be proper to observe, that they who cannot procure the purest and best sort thereof for medicinal Use, must serve themselves with such Rain or River-Water as can be had: but if these be not obtainable in tolerable Purity, the best way is to distil them; or else, upon a slight boiling, to correct them, by the addition of calcin'd Hart's-horn. It is doubtless a singular Benefit of Nature, to have large Cities and Countries well watered, with wholesome Springs; which thus bountifully supply so much better Remedies than those of the Shops. If every prudent and disinterested Physician would carefully examine into the Waters of the Place where he resides; he might thence assuredly practise more to the Satisfaction of himself and Service of his Patients, than in the common way, by the miscellaneous Use of numberless uncertain Remedies.

S E C T. VI.

Of WARM-BATHING.

1. **W**E are abundantly supplied with Remedies both by Nature and Art: but he who has been any time versed in the Practice of Physic, will find reason to drop the boasted Preparations of the Shops, tho' ever so highly extolled; and confine himself to the Use of a few simple

simple Medicines, that are easily prepared : for from these alone can any solid Advantage be justly expected. And surely it is a Mark of Wisdom and Goodness, that the most excellent of all Remedies should every where be found in the commonest Subjects, and such as are easiest to be procured. Thus we have already shewn, that common Water has a juster Claim to the Title of an universal Remedy, than any Medicine of the Laboratory or the Shop ; tho' ever so costly, or ever so laboriously prepared. And having proved the extraordinary and universal Use of pure Water, taken internally ; we here proceed to examine its Efficacy, when externally employ'd, in the way of Bath.

2. There is scarce any Remedy, which from the earliest Antiquity, and the general Practice of Nations, has been so much celebrated, and brought into common Use, as Bathing. The Egyptians, the Greeks, and the Romans, held the Practice of it in great Esteem ; were very magnificent in their Baths ; and finding them of eminent Service in the Preservation of Health, and the Prevention of Diseases, they, as is usual in the like Cases, run into an Abuse thereof, and turned them to Luxury and Pleasure. And hence the Magnificence of the Greeks, and Romans, was in nothing more conspicuous, than in the stately Structure of their Baths ; as we learn from Vitruvius, Seneca, Statius, Martial, and Pliny. On the other hand, all the most ancient and best Physicians ever held Bathing excellent ; both in the way of Prevention and Cure, even of the more obstinate and inveterate Distempers : thus seldom using any other Remedy besides Water, either internally or externally ; as Hippocrates, Aretaeus, Trallianus, Galen and Aetius assure us.

*Antiquity
and Uni-
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*The Suita-
bleness of
Bathing to
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3. But chiefly the Methodists held this kind of Remedy in high esteem ; whence *Celsus* * says of their Head, *Asclepiades*, that he used Bathing boldly ; and *Cælius Aurelianus*, the only Writer of the Methodists now remaining, highly magnifies Bathing in many obstinate Distempers. But it is the misfortune of our times, that Bathing seems almost excluded the Art of Medicine, so as to be seldom used ; or but in particular Cases ; and when the Disorder is seated in the external Parts. The reason hereof seems principally this ; that most Physicians imagine external Remedies of little efficacy in the Cure of internal Disorders. Besides, the Physicians of the present Age, generally attribute the Causes and Symptoms of Distempers more to the depraved State of the Blood and Juices, than to the altered Nature, Strength and moving Powers of the Solids ; whereas, in assigning the true Causes of Diseases, a principal Regard must be had to the Solids, which regulate the Motions of the Fluids ; and in this respect Bathing is extremely serviceable. Since, therefore, the Usefulness of Bathing is generally allowed in Diseases of the Skin, and others, that are seated externally ; it shall here be our principal Care to recommend the Practice of Bathing for the Cure of internal Disorders, whereto it is admirably fitted, upon the Attestation both of Reason and Experience.

Several
kinds of
Bathing.

4. There are several kinds of Baths, but we shall here speak only of the moist kind ; or such as consist of pure common Water. The Antients had ways of sweating by a dry Heat ; as by the means of hot Sand, Stove-Rooms, or artificial Bagnio's ; and again, by certain natural hot Steams of the Earth, received under a proper Arch, or
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* Lib. II. cap. 17.

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Hot-house, as we learn *from *Celsus* *. They had also another kind of Bath, by Insolation, where the Body was exposed to the Sun, for some time, in order to draw forth the superfluous Moisture from the inward Parts. And to this day it is a Practice, in some Nations, to cover the Body over with Horse-dung; especially in chronical Cases, to digest and breathe out the Humour that causes the Distemper.

5. Moist Bathing is of two kinds, hot and cold. Cold-Bathing was also in high Esteem among the antient Physicians, for the Cure of Diseases, as appears from *Strabo* †, *Pliny* †, *Hippocrates* ‡, and *Oribasius* **, whence washing in the Sea, and plunging in cold Water, were recommended by them. And this Practice agrees with Reason; for where the Heat diffused in the Body is to be collected, or brought upon the *Viscera*, and the Strength of the weakened Parts to be recovered, Cold is of more Service than Heat and Moisture. But Cold-Bathing is not our present Subject ††.

6. Again, the Waters which may be used for Bathing are of two kinds; viz. either pure and simple, or such as abound with heterogeneous Parts, of different kinds. Those we intend are the purest, lightest, and simplest, free from all participation of mineral or metallic Particles.

*The best
Water for
Warm-
Bathing.*

And

* Lib. II. cap. 17.

† Strab. in Geograph. Lib. LXV.

‡ Plin. Histor. Nat. Lib. XXIX. Cap. 1.

‖ Hippocrat. de Humidor. Usu.

** *Oribas.* Lib. VI. Cap. 27.

†† For fuller Information, the Reader may consult Sir *John Floyer* and Dr. *Baynard* on *Cold-Bathing*. But the Subject requires a farther experimental Treatment, to bring it upon the safe Footing of Warm-Bathing; and point out the necessary Rules and Cautions for a discreet and advantageous Use, in the several Cases whereto it is adapted.

And the external Use of such it is, that we would here recommend, in the Cure of internal Disorders. The Water therefore for this purpose should be what we call sweet ; that is, perfectly tasteless and scentless : which also, upon boiling, leaves no tastable Substance behind ; and approaches near to the State of distilled or Rain-Water : as may be readily and exactly discovered by its specific Gravity. This Water also should be such as does not turn thick, or precipitate with any metalline, or mineral Solution ; but easily heats over the Fire, and readily boils Pulse, or the Flesh of old Animals, tender ; and lastly, such as best serves the Purposes of Washing, and taking Stains out of Linnen, or extracting the Tincture of Tea. Such a kind of Water is that of Rain, collected in the free and open Air, remote from large Towns ; or that of Rivers, especially after the Land-floods come down into them. There are also some few Springs which afford a very subtile, pure and light Water, extremely proper both for internal and external medicinal Use.

7. Such light and simple Spring Waters as these, are to be highly valued, on account of the matchless Virtue they have, both in preserving and recovering Health. For 'tis the Property of these subtile Waters, readily to enter the Pores, and finest Canals of the Body ; dissolve all the gross Matter they meet in their way ; drink up the morbidic Salts ; and carry all Impurities clear out of the Habit. They have also the Property, when used externally, of softening and relaxing the dry and hardened Parts ; opening the Pores ; and procuring the requisite Fluidity and Circulation to the Blood : whence all the Parts of the Body are by their means commodiously water'd, recruited and repaired. And to say the

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truth, many natural hot Springs owe all their curative Virtue to the Subtilty and Purity of their Waters, especially when used in the way of Bath; as we have found in a Variety of Instances. And from many Discoveries of this kind, we are firmly persuaded, that warm Baths prepared of such sweet and subtile Waters, being used at proper Times and Seasons, will have the same Effects as the natural insipid hot Springs, that abound with no manifest saline or mineral Principle.

8. But as such soft and subtile Waters are not every where to be found, nor Rivers at hand in all places, 'tis necessary that we shew some way of correcting and softening the common Waters, so as to fit them for medicinal Use. And this we judge may be most advantageously perform'd by a small addition of fix'd alkaline Salt; or otherwise, by the Use of Bran, common Camomile, both the Herb and its Flowers; Linseed, Pease-straw, or Oat-meal: all which have the Power of taking off the Hardness of Waters, or rendering them soft and thin; so as to make them more easily enter the solid Parts of the Body.

6. We come next to explain the general Manner wherein Warm-Bathing acts. And first, when the Body is plunged in a pure, light and simple warm Water, the Heat necessarily rarifies and expands the Blood and all the Juices; and thus dilates the whole System of the Vessels. For 'tis the Nature and Property of all Heat, by the means of an extremely subtile, ætherial Matter, to insinuate itself into Fluids, and increase their internal Motion, enlarge their Bulk, or cause them to expand and rarify; as manifestly appears in the Thermometer. Upon this Dilatation of the Blood, the Pulse, or contractive
Stroke

*How
Warm-
Bathing
acts.*

Stroke of the Arteries, increases; whence the Blood circulates with greater Force, and the external Parts of the Body become red, and begin to sweat.

10. The Body suffers another Change from the Gravity or Pressure of the Water. This Pressure is known, from Geometry and Mechanics, to be eight hundred times greater than that of the Air; whence 'tis no wonder if the Body plunged in Water, be greatly altered; as its Surface in that Case sustains a violent Pressure, which squeezes the Blood forcibly inwards upon the *Viscera*. Thus, whilst the Vessels are compressed from without, and dilated from within, the intestine Motion of the constituent Parts of the Blood is increased: and consequently the viscid Juices are thus dissolved; Obstructions overcome; and the Humours better fitted to pass thro' all the secretory and excretory Ducts. And as, by the Water's Gravity, the Parts are compressed from without, and the Blood driven copiously into the Heart, Lungs, Brain, and larger Vessels; hence, if the Bath be too hot, it causes Palpitations of the Heart, Oppression in the *Viscera*, or sometimes Fainting: and again, when the Body is foul, or full of bad Juices, it produces continued Fevers; or inveterate Intermittents, if the first Passages abound with Crudities. These ill Effects are frequently observed in those hot Springs which have also an astringent Quality; as the violently hot *Caroline* Spring evidently has: insomuch that by bathing therein, whilst the Water continues over-heated, it produces Fevers of all kinds; and frequently such as are dangerous.

How
Warm-
Bathing
cures Dis-
eases.

11. Another Change ensues upon the Body from the Moisture of the Bath; which, assisted with a temperate Heat, procures a great Sup-
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pleness to the Skin, and Fibres: insomuch that upon coming out of the Water, the whole Habit of the Body swells considerably, is loosened in its Texture, and opened in its Pores, and Vessels; whilst the Blood and Juices have a more free Passage to the Surface. And hence it is, that if a Person goes directly out of the warm Bath to bed, he presently begins to sweat plentifully: which is the best Effect that can proceed from Bathing; and of great Service in the Cure of Diseases. It is therefore manifest, that the more subtile and light the Water of the Bath is, the greater Effect it will have, in relaxing the Parts contracted by spasmodic Disorders. And from this Relaxation, and suppling of the stiff and contracted Fibres, proceeds the Efficacy of warm Bathing in the Case of shrunk, dry, emaciated and cold Sinews, the Palsy, great Weakness and Inability of the Limbs, &c. And hence it likewise is, that the abdominal Parts also being softened and suppled by warm Bathing, the Delivery of Women thus becomes easier; and the Body, that was before costive, rendered soluble; the menstrual and hæmorrhoidal Flux restored; and a Suppression of Urine cured: which are known Effects of warm Bathing.

12. But tho' the Effects of this kind are allowed manifest, 'tis questioned by some, whether Warm-Bathing can be serviceable in Disorders of the internal and remote Parts of the Head, Breast, and lower Belly. We assert the affirmative, upon the footing both of Reason and Experience. For as warm bathing of the Feet, is of great Use in internal Diseases; such as the Head-ach, *Vertigo*, convulsive Asthma, dry Cough, hypochondriacal and hysterical Disorders, Palpitations of the Heart, &c. it may reasonably be expected, that the bathing of more Parts

*That
Warm-
Bathing is
curative of
internal
Disease.*

Parts of the Body in pure, warm Water, may be attended with greater Success. And in fact, we find the greatest Use of warm Bathing in those Distempers where, by a violent Contraction of the membranous Parts, the Blood is thrown upon others; and where both the Blood and Juices are prevented from coming to the Surface of the Body, or driven back upon the *Viscera*: which is indicated when the Extremities of the Body are cold and shrunk, the Belly costive, the Skin dry, and insensible Perspiration or Sweat obstructed. For in this Case, when the Habit of the Body is relaxed, its Texture opened, and the finer Vessels expanded; the Blood not only freely circulates on the Surface of the Body, but the Perspiration of the Skin is restored; and a great Quantity of Impurities made to pass thro' that widened Strainer. And hence, there is scarce a more immediate and assured Remedy, for removing Impurities, and cleansing the Juices, than warm Bathing, properly used: as it so successfully carries off all corrosive Matters, which being seated deep in the nervous and membranous Parts of the Body, occasion Pain, Spasms, or even Exulcerations; and discharges them at the open Pores, or fine Net of the Skin.

Useful in
the Venereal
Disease.

13. Warm Bathing is likewise admirable for cleansing the Mass of Blood from the venereal Taint: for, there is not a more expeditious and appropriated way of discharging a Matter which, by its Subtility and Acrimony, lodges in, and preys upon the solid Parts, and thus causes violent Symptoms in the nervous System, than by the Skin: whence the Venereal Disease is seldom totally eradicated, without the Use of warm Bathing. All experienced Physicians know of how little service, and yet how mischievous, that Method of curing the Venereal Disease is apt

to be, which turns upon the Use of drying Decoctions, and Mercurial Preparations; whether intended to sweat or salivate; unless Care be taken to discharge all the malignant Humour out of the Body; particularly by the Pores of the Skin. We could here produce numerous Instances of Cases where, by Mercurial Salivation, and the Use of Mercurial Preparations in the way of Diaphoretics, and Purgatives, assisted by sudorific Decoctions, the Symptoms have only been abated for a Season; and after a while unexpectedly returned, with greater Violence: because the Taint was not thoroughly discharged; but part remaining behind, gradually revived, and acquired fresh Force: whereas by nearly the same Course of Mercurials and drying Decoctions, together with a proper Use of warm Bathing, at due Intervals, the Cure has been compleated; and the virulent Matter entirely discharged from the very innermost Seat of the nervous Parts.

14. Warm-bathing is likewise excellent in that terrible Disease, the *Hydrophobia*, arising from the Bite of a mad Dog; whereby the Patient is at once tormented with Thrift and the Dread of Water. The only known Remedy in this Case is Bathing; which was used by the Ancients for that purpose. Thus *Celsus* relates it as “a Practice with some, after the Bite was received, immediately to plunge the Patient into a Bath, and there sweat him as long as his Strength would permit; being also careful to open the Wound, that the Poison might the more freely distil from it*, &c.” A Physician of *Dunderstad* lately informed me, that a mad Wolf coming out of the Woods, bit several Persons, who died of the Bite; till at length, by the Advice of an ordinary Man, some of them made

In the Hydrophobia.

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* See *Cels.* Lib. 5. Cap. 27.

use of a moderately hot Bath ; having first taken a Dose of *Venice Treacle*, and the *Fungus* of the Dog-rose : which Process being repeated every day, the rest were freed from Danger. For, warm Bathing becomes serviceable in this Case, by bringing the subtil Venom to the Surface of the Body, where it finds a free Exit. But here may arise a considerable Doubt, because the Ancients used cold Bathing for the same purpose ; which Treatment, by shutting up the Pores of the Body, might seem to detain the Poison, and throw it upon the inward Parts. Our Opinion is, that cold Bathing should not be absolutely condemned in this Case ; tho' it seems highly precarious and uncertain. However, if there follows upon its Use, a considerable Heat of the internal Parts, attended with a quick Pulse, and Sweating, which often happens ; it may then be of service : but if the Nerves become stiff and rigid by the Cold, it must needs be attended with Danger. And to prevent such an ill Effect, *Celsus* prudently advises to plunge the Patient in warm Oil, as soon as he comes out of the cold Bath.

In scorbutic and hypochondriacal Cases.

15. Warm Bathing, used with proper Caution, is also eminently serviceable in cleansing the Blood and Juices from such scorbutic Foulness as causes great Pains in the Limbs. The good Effect of the natural medicinal Springs, used both internally and externally, in this Case, is well known : But when these cannot be had, diluting, gently opening, and sweating Decoctions, with the Assistance of warm Bathing, at proper Intervals, may supply their place. It is scarce credible what a large Discharge of foul Humours is sometimes made by the Skin, into the Water of the warm Bath. To this purpose there is a remarkable History in the *German Miscellanies*, of

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of a Woman afflicted with a Pain in her Loins, who after trying other Things in vain, found nothing gave her so much Relief as warm Bathing; upon the Use whereof, for a few times, she grew better; after a gross unctuous Matter was observed floating upon the top of the Water; that might be taken off with a Spoon*. There is also subjoined another History of an hypochondriacal Man, who, upon a little Use of the warm Bath, found the Water began to smell fetid (with a gross black Matter floating on the top, which daily grew more corrosive) so as to occasion a Necessity of using fresh Herbs every time, to correct the noisome Smell, and Acrimony of the Water, which affected the Hand of the Rubber: and this continued till at length the Patient was happily recovered †.

16. But one of the capital Uses of warm Bathing is to cure such Diseases as firmly seat themselves in the upper parts of the Body. An eminent Instance of this we have in maniac Disorders; whether attended with Sadness or Raving: for Relief wherein, warm Bathing is extremely useful. The Persons subject to these Disorders are such as have the *Hypochondria* affected, or the nervous Parts of the lower Belly spasmodically bound and contracted: which is a Case attended with Costiveness, a great Constriction and Coldness of the Skin, and a gross and foul Mass of Blood, forcibly driven upon the

*Efficacy of
warm
Bathing in
the Cure of
Madness.*

N 2

Brain.

* *Miscellan. Natur. Curios. Decad. II. An. 6. Observat.*

239.

† When Persons apparently in Health, use the warm Bath, 'tis easy to observe a Quantity of unctuous Matter floating upon the Surface of the Water; which being admitted into the Mouth tastes very disagreeably to the Person bathing. And the Waiters at Bagnios know what great quantities of filthy unctuous Matters come from the Body in the warm Bath.

Brain. For if the Blood be copiously collected in the Vessels of the membranous Parts of the Brain, and flows therein with difficulty, it occasions numerous, terrible, and phantastic Apprehensions. But if in certain Constitutions there be, as it were, a particular Fever in the *Meninges* of the Brain; when the Blood runs violently thro' the Vessels thereof; it thus causes Raving, and such disorderly and furious Motions in the Patient, as render it necessary for him to be chained, to prevent his injuring others. The noble Effect which warm Bathing has in these Cases, is owing to nothing more than its softening, suppling and relaxing the nervous Parts, opening, by its Warmth and Moisture, the cold and hardened Skin, and thus deriving the Course of the Blood upon the Habit of the Body; and giving it a free and general Circulation. It is not, however, from Reason alone, but from a long Course of Experience, that we assert the Excellence of this Remedy, in these Cases: For we have seen numerous Instances, both of inveterate Melancholy, and raving Madness, happily cured by its means; after the Use of Bleeding, diluting Medicines, and Medicines consisting chiefly of Nitre. And this kind of Cure I have recommended to many foreign Physicians, who, as well as my self, find it highly beneficial. Whence I have often wondered that this Method of Cure for Madness, should be so much neglected in our Time; whilst Bathing has, from the earliest Ages, been employed for this purpose: insomuch that the ancient Physicians had recourse to it as a Thing they entirely depended upon. This will manifestly appear to those who consult *Trallianus* *, *Aretaeus* †, *Celsus*

* Alex. Trallian. *Lib. I. pag. 107.*

† Aret. *Lib. VII. pag. 134.*

Celsus Aurelianus, and Prosper Alpinus†.*

17. Warm-Bathing also proves serviceable in other Diseases of the Head; as deriving the Blood and Juices from thence to the remote or external Parts, by its Warmth and Moisture; which soften and relax them. Thus in that Epilepsy, which in Women arises from a Suppression of the menstrual Flux, we have known warm Bathing used to advantage, along with other Remedies. And *Trallianus* highly recommends it in this Distemper, to be used twice or thrice a Week, and rather before than after Meals‡. But the Bath must be refrained near the time the Fit is expected, lest thro' the Pressure of the Water upon the lower Parts, and the Expansion of the Humours by the Heat, they should flow up to the Head, now weakened and rendered unfit to receive them; whence a Fit might be hastened, and made more violent: but there is no danger in using this Remedy at proper Times, in the Interval of two Fits. We likewise find warm Bathing advantageous in severe and obstinate Pains of the Head, the *Vertigo*, short Distractions, proceeding from the hypochondriacal Disease, and in spasmodic Contractions of the lower Belly: For thus the warm Water not only derives the Motion of the Humours to the lower Parts; but also mollifies and relaxes the Contractions which cause these Disorders. So likewise in the *Epiphora*, sharp De-fluxions, and Inflammations of the Eyes, warm Bathing is of singular Efficacy.

18. But there is no Case wherein this Remedy proves of greater service than in the hypochondriacal Disease; which is not only a stubborn,

*And other
Diseases of
the Head.*

*The Efficacy of
Warm-Bathing in
the hypochondriacal Disease.*

N 3

* Cæl. Aurel. Lib. I. Morb. chronic. pag. 335.

† Prosp. Alpin. de Medicin. Ægypt. p. 115.

‡ Trallian. pag. 74.

but also a reigning Evil, at this Time; being commonly attended with a grievous Train of Symptoms, without intermission; and causing great Perplexity to Physicians, who have not hitherto discovered its perfect Cure. To speak the truth, there is no better, or more effectual Remedy, for relieving and eradicating this Distemper, than a proper Use of the hot and cold mineral Waters. But here we must observe that Bathing in the purest, and lightest Water, wonderfully seconds the internal Use of Medicinal Springs. For those Waters which are properest in Drinking, as containing a considerable Proportion of a heavy, earthy, and saline, or astringent, irony Matter, are not so proper for the purpose of Bathing, in this Distemper, as the purer. This has been confirmed to me by long Experience of the hot *Caroline* astringent Spring. And hysterical Women receive the same Advantages from Warm-Bathing as hypochondriacal Men.

*The Seat
and Na-
ture of the
hypochon-
driacal
Disease.*

19. To discover the reason of the powerful Effects of Warm-Bathing in these Cases, we must first examine into the Seat, Origin, Nature, and Symptoms of the hypochondriacal Disorder. And when all things are considered, this Disease appears to reside in that nervous and membranous Tube, wherein the Aliment is digested and dissolved, that is, in the Stomach and Intestines; the peristaltic Motion whereof, which naturally consists in a reciprocal Dilatation and Contraction, is plainly disturbed, or even inverted. And this chiefly proceeds from certain spasmodic and convulsive Contractions; whereby, if the lower Parts of the Intestines are affected, especially when full, the Excrements are not only detain'd in the Tube, but Flatulencies, or windy Vapours, generated and pent up;

up; so as to rise, and violently distend the smaller Guts and the Stomach. And thus all the nervous Parts, endowed with an exquisite Sense, are, by what the Ancients call Consent, drawn into a similar spasmodic Motion; whence proceed that numerous Train of Symptoms which afflict nearly all the Parts of the Body. If this Disorder has only a transient Cause, not seated in the Substance of the *Viscera*, it receives an easy Cure by proper Remedies. But if it also seizes upon the *Viscera*, especially the *Pancreas*, the Liver, the Spleen, or the Mesentery; and the Coats of the Intestines be injured, or destroyed; a thorough Cure can scarce be effected: for the Case is rather exasperated, and at length sometimes rendered incurable, by a frequent Change of Physicians, and Medicines; with which People in this Distemper vainly amuse and deceive themselves. From hence every Physician will perceive, that of all Remedies none is so efficacious as a warm, innocent Fluid, properly used, both externally and internally, for restoring the natural Tone or Tension of the intestinal Tube; easing and relaxing the spasmodic Contractions of these Parts; and re-instating the inverted peristaltic Motion; or directing it to its natural Tendency downwards. For thus the Water, by its agreeable Warmth, gently mollifies and relaxes the hardened and crisped Fibres, recalls the Blood and Humours that were before excluded, and causes a free Circulation of the Juices thro' the Vessels of the Intestines. And this Virtue of warm Water was not unknown to *Hippocrates*; who says expressly, that “it softens and supple the Skin, eases Pain, relaxes Contractions, takes off Convulsions and Distensions; and cures Heaviness of the Head*.”

The warm Bath proper for the hyponchondriacal Disease.

N 4

And

* Aphorism. 22. Sect. V.

And by this same Property it is, that warm Bathing cures all such Distempers as proceed from a Contraction and Spasm of the Parts of the lower Belly. Of this kind are Pains in the Intestines, Gripings, violent convulsive Colics, heavy Pains and Contractions occasioned by the Stone in the Kidneys; and attended with Suppression of Urine, Costiveness, &c. in all which Cases the warm Bath is eminently serviceable. It must however be observed in the convulsive Colic, proceeding from a Stagnation of the Blood, if the Body is full or overcharged with Juices, warm Bathing becomes unsafe; except some Blood be first taken away*. But in such Colics as proceed from Hardness of the Extremities, a Bath prepared with emollient Ingredients, is highly serviceable, along with proper laxative Medicines; such as Oil of sweet Almonds, Manna, Epsom Salt, Cream of Tartar, &c. This kind of Bathing also deserves to be recommended in the Hic Passio; especially if a Portion of the Ileum, confined in the Scrota, be the Cause thereof: for if any thing can contribute towards re-placing that Intestine, whilst fill'd with Flatulencies and Excrements, there will scarce be found a more assured Remedy than the warm Bath.

*Effect of
warm
Bathing in
the Stone.*

20. Warm Bathing is likewise peculiarly adapted to ease the Torture proceeding from a Stone in the Kidneys. For if the Stone, lodged in the finer Conduits of the Urine, be somewhat large, it occasions spasmodic Contractions; not only in the Passages of the Urine, but in all the nervous Parts of the Body. In this Case, therefore, nothing is more advisable than to detain the Body in a temperate Bath; by the Warmth whereof the Contractions of the Parts will

* See Trallian. Oper. pag. 591.

will be so relaxed, as not only to mitigate the Pain, but likewise promote an easier Exclusion of the Stone, thro' the Canals that may be thereby suppld and widened, to admit thereof. And this Remedy, for the present purpose, is not only found effectual in our Age, but was also recommended by the ancient Physicians *. And with regard to the Use hereof, we have observed, that when a very large Stone sticks in the Cavity of the *Urethra*, it occasions a violent Pain about the *Os Pubis*; but this Pain is not at all felt, so long as the Patient remains in the Bath. Particular Care must, however, be had, not to advise the Bath too hot in Cases of the Stone; especially if the Body be full of Blood, youthful and florid: otherwise a Fever might easily be occasioned, as Experience testifies.

21. 'Tis a Question of great moment, whether Warm-Bathing be serviceable in Fevers. The Ancients, particularly *Hippocrates*, *Galen*, *Celsus*, and the *Methodists*, held the Use of Bathing in great esteem, for the Cure of Fevers; especially Intermittents: and this chiefly in the Interval of two Fits, or when the Fit was going off; or even in the beginning of an ardent Fever †. Upon consulting such of the Ancients as have wrote upon this Particular ‡, and comparing them with Experience, we find reason to assert that Bathing is very serviceable, being used the Day after the Fit of an Intermittent; and again when the first Passages have, by means of opening and relaxing Salts, been thoroughly cleansed of their Impurities. For the

*Whether
the Warm-
Bath be
proper in
Fevers.*

* See Alexan. Trallian. pag. 543, 547, 551. Aret. pag. 118.

† See Trallian. pag. 543, 547, 551. and Aret. pag. 118.

‡ See Galen. Method. Medend. Lib. VIII. cap. 3. Alpin. de Medicin. Ægyptior. Trallian. Lib. XII. pag. 735. Galen. Lib. de Therap. Cels. Lib. II. cap. 17. & pag. 105.

corrupt Humour, which causes Fevers, cannot with greater Safety be discharged the Body, than by relaxing the Skin; especially if a sweating Medicine be taken before going into the Bath. But when the Fit is approaching, or actually come on, Bathing must be refrain'd, as improper; according to the Direction of *Hippocrates* *. The same Remedy is likewise very serviceable in the Decline of an Intermittent †. *Platerus* also, advantageously used Warm-Bathing in a Quartan, on the Day before the Fit ‡.

That
Warm-
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forwards
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tion of o-
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medies.

22. We add, that the Operation of other Remedies is wonderfully forwarded and promoted by Warm-Bathing; so as to render them productive of much greater Effects. Thus, according to our Opinion, and Experience, 'tis seldom proper to direct a Course of Mercurials, with Intention to salivate, or to sweat, either in the venereal Disease, or other obstinate Cases, without interposing the Use of Warm-Bathing: for this so softens and relaxes the Skin, and opens the Pores, that the corrupt Humours cannot, with such Violence, fall upon the Jaws, or other Parts; but are in great measure dislodged from their innermost Cells, and discharged, thro' the cuticular Strainer: whence, under such Regulation, a Cure may be very safely and advantageously prosecuted with Mercurials. The Ancients, who had no Knowledge of any chemical, or other very powerful Remedies, made use of white Hellebore in obstinate Cases; but scarce ever prescribed it without directing the warm Bath first: which not only liquifies the Blood and Juices, and renders them more moveable; but also opens the Passages, for the better discharge of

* De Morb. Mulier. pag. 151.

† See Cels. pag. 105.

‡ Observat. Lib. II. pag. 281.

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of the peccant Humour. *And in this manner there was no great Danger of producing any violent Symptoms, by the Use of such rough Purgatives as operate by spasmodical Contractions. Thus likewise, Steel Medicines have a considerable Efficacy in the Cure of chronical and hypochondriacal Disorders; but to prevent such Remedies from proving mischievous, it is highly proper to use warm Bathing between whiles; whereby the offending Humours are the better prepared for Dislodgement and Exclusion. And no question but the Bark, and other astringent Remedies, of use for putting by the Fit of an Intermittent, may be given with much greater Safety, under a proper Course of warm Bathing.

23. For a Conclusion, we shall lay down a few Rules to prevent the warm Bath from proving prejudicial. And (1.) it should never be used too hot, but always temperate; in which State it must be constantly kept all the time, by the gradual Addition of hot Water, to prevent its cooling. (2.) Where the Body is full of Blood, or abounds with ill Juices, the Bath should never be used, before some Blood is taken away; or the proper Evacuations made, by gentle Purgatives, or otherwise. (3.) The most suitable time for Bathing is the Morning, when Digestion has been perform'd, and the Stomach remains empty: and more particularly whilst the Body is not costive. (4.) Lastly, the Person must not stay in too long, for fear of weakening the Body: and when he comes out, he should go directly to Bed; to prevent taking cold, and to promote a plentiful discharge by Sweat; which may be forwarded by the drinking of any proper warm Broth, or Decoction.

*Rules for
Bathing.*

S E C T. VII.

*Of the Ways of imitating Mineral Waters,
so as to supply the Decay, Failure, or Want
of particular Springs.*

*Whether
Mineral
Waters
are imi-
table by
Art.*

i. **A**S it appears from the preceding Sections, that Mineral Waters, for the Prevention and Cure of Diseases, have no known Remedy comparable to them; as all Persons cannot have an Opportunity of frequenting the Wells; and as the Springs themselves are sometimes, tho' rarely, subject to Decay; it becomes a Question of importance, whether, from a Knowledge of the Principles and Ingredients of these Waters, they may not be imitated by Art; or the more common Waters of every Place, be impregnated, so as to produce the same Effects? Many Chemists of the last Age held the Affirmative; and in particular, imagined that cold Mineral Springs were easy to be imitated. But they certainly went upon a false Notion; which with many prevails to this day; that these Waters owed their principal Virtue to a vitriolic Substance; and thence imagined, that they needed but dissolve such a Substance in pure Spring-Water, and the thing was done. But, upon Trial, they found their Error; for there is no solid Vitriol contain'd in these Waters. Nor is there a single Instance of a Spring, that we know of, holding a Salt, so far like that of common Vitriol, as when separated, and again dissolved in Water, to turn inky with Galls; make a *Tartarus Vitriolatus* with Oil of Tartar; and when ground with Nitre, to yield the Fumes of *Aqua fortis*.

2. To lay a Foundation* for a more successful Imitation of Mineral Springs, we must observe, that there are some, both of the hot and cold kind, which contain no saline or mineral Principle at all; and are nothing but a very pure, subtile, and light Water: which, however, has very considerable medicinal Virtues. If such Spring-Water as this be not procurable; we may, perhaps, to as good advantage, use, in its stead, the purest Rain-Water*.

*Foundation
of the
Things.*

3. There are certain Springs, of a very light and subtile Water, containing no earthy or saline Principle; and only a small quantity of an irony Substance: and these may properly be called Iron Waters; for they exhibit no Change to the Eye upon the admixture of Acids or Alkalies: but by standing, or being heated, deposite a yellow okery Sediment. It is, therefore, no difficulty to imitate this kind of Water, by Art; where a sufficient Quantity of a pure, light and simple Water is at hand. The Method is only to boil it, in a Glass Vessel, with a little of the more curious and subtile Oker sold in the Shops; by which means the Water will acquire

*To imitate
pure Iron
Waters.*

* As the Uses of pure Rain-Water are numerous, and extensive, it may be worth considering how to obtain it in Plenty and Perfection. It might be expedient to have some little Buildings, or Rain-Water-Houses, for this purpose, near large Towns; with a Superintendant to distribute this useful Fluid: It were easy to contrive a way of excluding all manner of Filth or Boulness from the Tops of such Buildings, their Conduit-Pipes and Reservoirs; and only uncover them at the time of Rain. And if Men were convinced of the Benefit and Extent of such a Design, they would not, perhaps, be long before they reduced it to Practice. The Family Uses of such Water are known to many; but its Wholesomeness, medicinal Virtues; both internal and external, its Suitableness to the making of artificial Mineral Waters, its great Uses in Pharmacy, Chemistry, and other particular Arts and Trades, are known but to few.

*To imitate
the saline
Iron Wa-
ters.*

a like Virtue, both internal and external, with those of the natural Iron-Springs.

4. There are other Springs remarkable for the Lightness and Subtilty of their Water, which, besides a small Proportion of Iron-Oker, hold a considerable Quantity of common Salt; whence they derive their principal Virtue. These Waters are somewhat purgative; and may be advantageously used in the way of Bath. They suffer no apparent Change upon mixing with Acids, or Alkalies; and do not abound with a mineral elastic Spirit. Such Waters, therefore, may commodiously be imitated by dissolving a little Sal-Gem in the above-mentioned natural, or artificial, Iron-Water.

*To imitate
those call'd
Acidule,
and the
Pyrmont
Waters.*

5. The Imitation of the cold and brisk Mineral Springs is attended with greater difficulty; if we would prepare them in such a manner as to have the natural, quick and pungent Taste, Smell, and copious elastic Spirit. I have, however, attempted to imitate them, by adding to the finest simple Water I could procure, contain'd in an earthen Vessel, with a narrow Neck, first, a little highly calcin'd and dissolved Salt of Tartar, next a little Spirit of Vitriol, so as to make an Ebullition, yet suffer the alkaline Principle to predominate; then shaking the Vessel, whilst it remain'd close stop'd. By this means I obtain'd a Water resembling the natural brisk and sparkling Waters. It likewise answers the natural Water in its Virtues, and Effects; so that I have given it, with great advantage, in such Distempers as required the drinking of the moderate, brisk, and cold Mineral Waters; where the natural ones could not be procured. But if the Design be to imitate the *Pyrmont* Steel Waters, which abound with an Iron Oker; either the natural or artificial Iron-Waters should be

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chose for the purpose, and a somewhat larger Proportion of Salt of Tartar, and Spirit of Vitriol, be used ; but so that the Alkali may still prevail *.

6. There are, besides these, certain purgative Mineral Waters, which tho' they make an Ebullition with Acids ; yet leave a bitter, neutral Salt upon Evaporation. These Waters are to be imitated in the same manner, by the means of Oil of Tartar, Spirit of Vitriol, and *Epsom* Salt ; or that prepared from white Manganese and Spirit of Vitriol. And much after the same way may be artificially prepared a Water abounding with an exquisite neutral Salt ; and capable of purging very effectually. The way is to dissolve, in the purest and lightest simple Water, a suitable Proportion of *Glauber's* Salt. Or a still better Method is by mixing oil of Vitriol with the white Manganese, so as to obtain from that calcarious

*To imitate
the purg-
ing Wa-
ters.*

Earth,

* There are Reasons to apprehend, that either this Expedient, or a worse, is practised at *London* and elsewhere ; so as to imitate the *Sparw*, the *Pyrmont*, and other foreign Waters, in such a manner as to pass undiscovered upon ordinary Judges. If these Dealers had Art enough to make their Imitations perfect ; the Deceit were the more tolerable : But as they commonly manage it, every Drinker who cannot procure the genuine, had better make the artificial himself, fresh as he wants it ; which he may do by the Help of these Directions. And to those who are curious in this particular, we recommend the purest Rain-Water ; and instead of Spirit of Vitriol, the true Spirit of Sulphur. But for a Method of imitating these Waters, which comes still nearer to that of Nature ; we think proper to intimate, that many Experiments and Observations shew the mineral Spirit, the specific Virtues, and irony Principle of Steel-Waters, to proceed from the *Pyrites*, dissolved by such Waters under-ground. Whence, perhaps, Beds of these Stones might be laid in the Course of a pure Spring ; so as to grow hot, steam, and richly impregnate the Water that runs near them ; without turning to Vitriol. The Experiment is recommended to the Skilful in Chemistry, and natural History.

Earth, and the vitriolic Acid, a Salt, after the same manner as it is prepared by Nature; and then dissolve this Salt in the pure Water, so as to equal the Proportions of that proposed to be imitated: For example, in the Quantity of about two Drams to twelve Ounces. *

To imitate
the bot.
Well Wa-
ters.

7. Lastly, if any one desires to imitate the *Caroline Waters*, which are extremely alkaline, and somewhat purgative, he should endeavour to procure, not a light and subtle Water, but such as is loaded with a calcarious Earth; and drop into this, first the Spirit of Vitriol, and afterwards the Solution of Salt of Tartar, till the Alkali manifestly predominates. The Spirit of Vitriol should be first poured in, that it may lay hold of the calcarious Earth; and therewith turn into a neutral and somewhat purgative Salt. †

8. These are the ways I have my self tried, to imitate the natural Mineral Waters for internal Use. And upon examining the Principles and Contents of these artificial Waters, they appear to hold not only the grosser earthy and saline Substances, but also something extremely like the curious elastic mineral Principle of the natural Waters; proceeding from the Action and Reaction

* To make it equal the Strength of the *Sadler's Waters*; which are much stronger than those of *Epsom*.

† These Imitations confirm the Practicability and Certainty of determining the Principles, Contents and Virtues of Mineral Springs, by a proper chemical Analysis; and indicate the Means even of improving upon Nature. At least, if a Person be tolerably versed in Chemistry, and the Business of Experiments, it will not be difficult to assign, *a priori*, the Virtues and Uses of any Water proposed; whence it might not, perhaps, be amiss, if a few Persons, thus qualified, were employed in examining the Mineral Waters of England. Something of this kind was intended by the *Royal Academy of Sciences at Paris*; as we learn from the *Sieur du Clos*: and the Attempt indeed was worthy of them, tho' the Performance be very defective.

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action attending a state of Effervescence *. They likewise, upon Trial, appear to have great medicinal Virtues; so as to be, with desirable Advantage, exhibited for cleansing the Blood, and curing numerous Diseases, according to their several Intentions: Tho' I cannot say, nor will pretend, that they come up to the Excellence of the natural Waters.

9. It remains that we shew a Method of preparing Waters, for external Use, so as to supply the want of Mineral Springs for Bathing. We formerly intimated how, by the Addition of Salt of Tartar, Pot-ash, Flowers and Herbs, wholesome Baths may be commodiously prepared; and shall therefore, in this place, touch upon such as may be made by the Means of Metalline *Scoriae*. The most common and useful of this kind are those prepared with the *Scoria* of Iron; which abounds with the earthy, saline and sulphureous Substance of the Metal. And these are of excellent Services for strengthening and bracing up the Parts, and recovering weak and decayed Limbs; stopping various kinds of Bleeding, and restoring the menstrual and hæmorrhoidal Flux, where obstructed; so that they may well be substituted for the natural Iron-Baths.

10. Adjacent to the Smelting-huts, where Metals are run from their Ore, are to be found large quantities of the Slag of Copper, Antimony and Cobalt; which abounding with Sulphur, vitriolic Salt, and an earthy Principle, make serviceable Baths, for strengthening the

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* We before intimated that the natural Medicinal Springs appear to have a kind of Effervescence, or what we vulgarly call Fermentation: and upon an analytical Comparison, there will be found a considerable Affinity betwixt some Wines and the brisk Mineral Waters, especially with regard to their fermentable and changeable State.

To imitate
the natural
Baths.

lost Tone of the Fibres, and relaxing them when they are too crisp. These Baths have likewise a deterfive and cleansing Virtue ; so that, with Prudence, and a due Regard to Circumstances, they may be used on many Occasions. The way of making these artificial Baths, is either to take the Slags, as they come hot from the Furnace, or else to heat them afresh, and throw them into hot Water, contained in a close covered Vessel ; that they may communicate their Virtue to the Water : which is afterwards to be used either in the way of Bath, or Fomentation, occasionally. To conclude, There are other artificial Baths prepared of Alum and Quick-Lime, by boiling them together in fine Rain-Water ; and such Baths are highly serviceable in paralytic Disorders, and Weakness of the Limbs.



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F I N I S.

CORRIGENDA.

- Pag. 87. *lin. ult.* for the separate, read these operate.
 Pag. 142. *l. 30.* for cathara, read catarrhs.

(2)

AN
ENQUIRY
INTO THE
CONTENTS, VIRTUES
and USES,
OF THE

Scarborough SPAW-WATERS:

WITH

DIRECTIONS for examining any other
MINERAL WATER.

M A

ERRATA.

PAG 26 l. 27 and p. 27 l. 2 for *unctious* r. *unctuous*
 p. 47 l. 4 for *fir* r. *last*; p. 47 l. 26 after *couple*
insert with p. 51 l. 21 for *and* r. *or*; p. 62 l. 30 after
particular insert Nature; p. 63 l. 19 for *bot* r. *hit*; p. 66
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insert of Heat; p. 74 l. 22-24 read *thus*, if other, the
 like Glasses, and Bladders, be also filled, or half filled, with
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 secured, &c. p. 78 l. 22 for *and* r. *are*; p. 95 l. 19 after
Part, insert and; ib. l. 21 for *Passages* r. *passes*; p. 98
 l. 16 after *time, insert* giving; p. 103 l. 24 *dele* the se-
 cond this; p. 107 l. 12 before *earthy, insert* the; p. 110
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 for *neutral* r. *natural*; p. 135 l. 13 for *Edulurants*, read
Edulcorants; p. 149 l. 27 after *produce, insert* it; p. 155
 l. 29 before *Powder, insert* the.



I W

DIRECTIONS FOR EXAMINING AND OTHER
 MINERAL WATER.

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T R A 2

A N

AN
ENQUIRY

INTO
The CONTENTS, VIRTUES, and USES
OF THE
Scarborough SPAW-WATERS, &c.

PART I.
The ORDER of ENQUIRY.

SECT. I.
Of the LAWS of ENQUIRY.

THE Disputes that have happened about the Examination of these Waters^a, make it necessary to settle the Laws of the present Enquiry, before it be gone upon: otherwise much Time, and Pains, might be fruitlessly employ'd; and the Subject, after all, remain dark and confused.

^a See Dr. Wittie, Simpson, Tonstal, Lister, &c. upon the Scarborough Spaw-Waters.

Conditions, or Laws of the Enquiry.

LAW I.

2. As the present Enquiry is physical^b, or concerned with material Objects; let it proceed upon physical Observations, Experiments, and the Art of Reasoning: these being the Instruments, or Means, of promoting Natural Knowledge; and, in particular, of discovering the Contents, Virtues and Uses of Mineral Waters.

EXPLANATION.

3. The Thing here intended being an Enquiry into the Contents, Virtues and Uses of a certain Water; this Enquiry must, of necessity, be carried on by the Assistance of physical Observations and Experiments: For, it is not in the Power of Imagination, Conjecture, abstract Reasoning, or any Thing else, without Observation, and Experiment, to assign the Contents, Virtues, and Uses of a Mineral Water. And the Art of Reasoning should here be employ'd only to suggest, and direct, the proper Experiments, and Observations, to be made; compare them together; draw out the Result; and direct a Renewal, or farther Prosecution, of the Enquiry; till, at length, it may end in a perfect physical History of the

^b By the Word *physical* is here meant, not medicinal; but what is usually express'd by the Words *natural* and *experimental*: tho' *physical* implies still more; and includes whatever relates to a Subject, consider'd as Matter, or a material Object. Thus the physical History of any Mineral Water, is the Natural, Experimental, Medicinal, Oeconomical, or Practical and Theoretical History of that Water.



Sub-

Sect. I. *Laws of ENQUIRY.*

Subject. Whence we derive a fundamental Rule, directing us, in the present Undertaking, (1) what to avoid; (2) what to pursue; and (3) what Method to take; as may appear below.

LAW II.

4. Let nothing be admitted into this Enquiry besides (1) Matters of Fact, or History, belonging to the Subject; (2) Matters of Observation regarding the same; (3) Suitable Experiments; and (4) Matter of Reasoning, in direct relation to the preceding Particulars: omitting whatever is foreign to the Design of a physical Enquiry; whether Matters of Learning, or Quotations; Matters of Dispute, or mere Speculation: For we are not here to diviate, confute, conjecture, or suppose; but to find out the Facts and Laws of Nature.

EXPLANATION.

5. The Reason for admitting of nothing, in this Enquiry, besides Fact, Observation, Experiment, and the Use of the rational Faculty, is that these are sufficient to form a compleat physical History of the Subject; which is the End of a physical Enquiry: and again, because whatever is of a different kind, draws the Mind off, or diverts the Enquiry; and swells the Discourse, without adding to its real Merit, or Use.

LAW III.

6. Let the Facts, Experiments, and Observations employ'd be not wholly of the vulgar, and obvious, kind; but let others be sought after, and made, with Choice and Design; so as to en-

ter the Nature of the Subject; and either bring Light, and Information, to the Mind, or Advantage to the Enquiry; with a View to its ending in an exact and full History.

EXPLANATION.

7. Common Facts, Observations, and Experiments seldom go far in discovering the internal Nature of a physical Subject; which usually lies deep, and requires to be searched into with Application and Address, before it will open, or manifest itself: and in this Light, Observations, and Experiments, properly made and tried, may be consider'd as the Tortures of Art, that bring Nature to a Confession. And thus, when a competent number of select Facts, Observations, and Experiments, are procured, ranged, and compared together, and their Consequences deduced, in natural Order; this will, by degrees, and as it were spontaneously, give us the physical History of the Subject.

LAW IV.

8. Let the Method observed be the direct Method of Enquiry, or Investigation; which proceeds from one Particular to another; so as at length, to come at more general, or comprehensive, Truths; in the Way of a physical Induction^c: whence the Sum, or Result, of the Enquiry may, at last, appear in a few general Corollaries, or Deductions; which, in a con-

^c By *physical Induction* is meant the Art of pursuing Subject thro' all its Heads, till the physical History thereof be obtained; and the natural Consequences deduced. See this more fully explained hereafter under Sect. IV. §. 3 — 7.

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Sect. I. *Laws of ENQUIRY.*

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tracted View, will exhibit the principal Fruits of the Enquiry; and, so far as that is carried, give both the Theory and Practice relating to the Subject.

EXPLANATION.

9. The Particulars directed by this Law are, (1) that certain Heads, or Articles, of Enquiry, be first proposed, as Questions to be solved; with Directions for doing it: (2) that the several Ways of Trial, or the Experiments designed to assist the Enquiry, be previously explained, and their validity consider'd: (3) that the necessary Cautions be all along given, and the Circumstances of the Experiments, and Observations, noted; for the better enabling others, by a Repetition, to falsify, verify, or improve them: and (4) that Care be taken to render the whole Procedure intelligible; by using a plain Style, a clear Method, and an Exactness in relating of Facts, Experiments and Observations; so that every one may judge how far the Enquiry is just, how far defective, or how it may be advanced, and perfected: these Particulars being necessary in a physical Induction.

S E C T. II.

Of the Heads, or Articles of Enquiry.

1. It is of considerable Use, in the beginning of a natural Enquiry, to have a comprehensive Set of Heads, or leading Questions, previously drawn up, in some tolerable Order; so as to point out the principal Particulars to be enquired after; lead into the Method of prosecuting

the Enquiry; and direct the several Steps to be taken in it: For the whole Business being thus divided into manageable Parts, each of them may be separately wrought upon, to advantage; whilst, by this Contrivance, the Mind is less distracted; and a prepared, or digested, Matter more readily furnished for a History of the Subject: tho' this Matter, these Heads, and the Method itself, must necessarily, at first, be rough and imperfect; so as to require alteration, and amendment, when the History shall come to be wrote.

2. Every Mineral Water may deserve to be enquired after in three general States; viz. (1) in its Rise, or Passage under Ground, and Receptacle; (2) in a State of Separation from the Spring, Course or Well; and as contain'd in Vessels, or Glasses: and (3) as drank by Men, or taken into the Body. These three States must be, therefore, regarded in our Articles of Enquiry.

I.

The Waters consider'd in their Rise, Course, and Receptacle.

Article 1. What is the Situation of the Well, or Receptacle?

3. This Question chiefly regards the Situation of the Well with respect to the Course of the Sun, the blowing of the Winds, and the nature and form of the circumjacent Country: as these Particulars are necessary to be enquired into, on several Accounts. Thus, for example, if a Water, abounding with a volatile mineral Substance, or Spirit, should be strongly beat upon, in its Receptacle, by the Rays of the Sun, or by the Winds,

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Sect. II. *Articles of ENQUIRY.*

Winds; these might carry off some part of the Spirit, and render the Water less brisk, or active. So again, if the Well should lye low, or near the Sea; this might subject it to be overflowed by the Tides; or to have its Water weaken'd by Rain, or other common Waters, falling into it, from the higher Grounds, &c.

What is the Rise, and Course, of the Water to the Article 2. Well?

4. This may sometimes be difficult, or impracticable, to trace, on account of Mountains, Lakes, or other intervening Obstacles: tho' the Thing itself is of Consequence; as it might lay open the Beds, and discover the Mineral Matters, thro' which the Water runs, or is strained: for it may be suspected, that Mineral Waters are no more than common Water impregnated with certain Mineral Substances, capable of dissolving, or lodging, therein. And under this Head it might be proper to enquire into the physical Origin, and Cause, or Causes, of Springs, in general; since considerable Light might thence be derived to the present Enquiry.

What Minerals lie in the contiguous and circumja-cent Parts?

5. This Question has an affinity with the foregoing; but carries the View farther; and directs an Enquiry to be made near the Confines of the Water-Course, and the Well-Head; in order to discover the Mineral Matters that are lodged, or bedded, there; particularly the softer or more volatile kinds, and such as, upon trial, are found to communicate any new, or uncommon, Property to Water: because such Matters may affect the Mineral Water, by their Effluvia,

or Exhalations^d, tho' the Matters themselves lie at some distance from the Course of the Water.

Article 4. What Substance, or Substances, are left, or deposited, by the Water, on the Sides, or Bottom, of the Channel, or Receptacle?

6. These Substances, whatever they are, being compared with the softer, or more soluble, Mineral Matters, found in the Course of the Spring, or adjacent to it, may help to discover the Contents of the Water. Thus, for instance, if a soft, soluble, Oker be found in, or near, the Course of the Spring; and a soft ochry Substance be found deposited on the Sides, the Bottom, or Confines of the Channel, or Receptacle; there will be a Presumption that the Water, in the Receptacle, is impregnated with the lighter parts of such Oker: tho' the Confirmation thereof must be had from particular Experiments, capable of manifesting that the Water actually contains such ochry Particles^e.

Article 5. Are any visible Fumes, Exhalations, Exudations, Efflorescences^f, or saline Concretions, to be found near the Course of the Water?

7. If any thing of this kind appears, it should be carefully examined into; because the Waters

^d By *Effluvia* are here meant, the fine, or almost insensible, Particles, which, in a dry form, fly off from Bodies; and by *Exhalations*, those that fly off from them in a moist one.

^e See this Matter farther explain'd hereafter, under Sect. IV.

^f By *Exudations* are here understood any mineral Juices that appear to sweat, or ouze, out of mineral Matters; or such mineral Juices as, by standing, or being exposed to the Sun, or open Air, harden, crystallize, or concrete, into Salts, or Vitriols. And by *Efflorescences* are meant the appearance of any light, mealy, or saline Matter, covering a mineral Substance, in the form of Snow, Down, Feathers, or Flowers.

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SECT. II. *Articles of ENQUIRY*

may hence be easily impregnated; as we see by the Fumes of burning Brimstone, and the Exudations, or Efflorescences, of those called Marcasites, or Pyrites; which sweat out a vitriolick Juice, or Salt, in the open Air: and most saline Concretions readily dissolve in Water; so as by Rain, or otherwise, to be easily washed down, and carried into the Course, or Receptacle, of a Spring.

Can any part of the Water, in its Course, be discovered to be of the nature of common Water; and to begin to receive its mineral Properties at a certain Place; either by passing over certain Beds of mineral Matters, or by receiving any mineral Fumes, or Juices, before it comes to the Receptacle? Article 6.

8. This Question carries on the View of the second, and third; and may afford great Light in the Enquiry: or, possibly, lead to the Discovery of *Artificial Methods of preparing Mineral Waters.*

Does the Water come to the Receptacle in one Stream, or more? If in more, is there any difference betwixt them; or do they any where mix before they arrive at the Well? Article 7.

9. It seems possible, where there are several Streams, that one may be richer, or more im-

^s *Marcasites, or Pyrites, are a certain kind of stony Matters, whereof Vitriol. or common Copperas, is usually made. When broke they appear shining and metallick: but burn blue in the Fire; and afford, upon fusion, only a small proportion of Metal; or seldom more than a Regulus, or imperfect metallick Substance. They are plentifully found in England; and may deserve to have their History, traced; particularly with a View to mineral Waters: for there are some Reasons to suspect that these are often the Cause of hot Springs; as they conceive heat with moisture; and may, perhaps, yield what may be called a mineral Spirit.*

pregnated

pregnated with mineral Virtue, than another so that a Receptacle being made for the strongest, this alone may be preserved, unmixed with the weaker; and thus the Water be rendered more medicinal.

Article 8. Is there only one Receptacle, or more? If more, what is their distance, and difference, from each other? Or, are they supplied by the same Streams, as to number, or quantity and quality of the Water, or do they communicate with each other?

10. If any difference be found in the Contents, or Virtues, of the Waters of the different Receptacles, Physicians may thence direct the use of any one preferably to the rest; according to the difference of Diseases, and Constitutions.

Article 9. What are the Materials, and Dimensions, of the Receptacle, or Receptacles; how often are they filled in 24 hours; or what is the quantity of Water afforded by the Spring in a given Time?

11. This Article tends to shew whether the Matter of the Basen be suited to the nature of the Water; by what number of Drinkers the Spring may be frequented; how often the Water is renew'd; how far it is capable of answering the Demands there may be for it, at home and abroad; and whether the Receptacle is duly proportion'd to the Spring, for preserving the Water, and affording it fresh and perfect.

Article 10. What other Springs, or Waters, are found near the Place of the Spring; and what are their Contents, Virtues, and Uses?

12. Tho' this Article has but a remote Relation to the Subject; yet it claims admittance into the Enquiry; as it may shew a Difference be-

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SECT. II. *Articles of ENQUIRY.*

betwixt the adjacent Waters; discover some that may be properly mixed, for particular purposes, with those of the Spaw, and used in the making of Experiments.

Is there any Scum, or other light Matter, found upon the Surface of the Water; and if there be, what is the Nature and Properties thereof? Article 11.

13. This Article may have its use in discovering the Contents, and Virtues, of the Water; as such a Scum, or light floating Matter, may contain certain Parts of the Water, or impregnating mineral Matters, condensed, or brought into a small Compass.

How long has the Water been discover'd? How has it been preserv'd? What Alterations has it undergone, with regard to the Accidents of Time, the Weather, Ruins, or other Contingencies? Article 12.

14. This Article may procure Light, not only to the present Enquiry; but likewise to others of the same kind.

What are the sensible Qualities of the Water in its Receptacle; or what are its degrees of Coldness, Clearness, Quickness to the Smell, Briskness to the Taste, and Specifick Gravityⁿ? In particular, is the Water brisker, or more spirituous, when taken from near the Bottom, than when taken near the upper Surface of the Well? Article 13.

ⁿ By Specifick Gravity is meant the relative weight of a Body, compared with that of another, or of common Water. Thus to determine the Specifick Gravity of a mineral Water, is to determine how much it is lighter, or heavier, in the same bulk, or measure, than common Water. A Pint of common Water weighs nearly a Pound: but a Pint of certain Mineral Waters weighs considerably less than a Pound: that is, such Mineral Waters are so much specifically lighter than common Water.

15. The

15. The determination of these Particulars may shew the Advantages, or Disadvantages, of keeping the Well open, and taking the Water up by the Hand; or keeping the Well close, and raising the Water by means of a Pump.

16. And these are the principal Heads that occur, with relation to the Waters in their Rise, Course, and Receptacle, upon the first View of the Subject.

II.

The Waters consider'd in a State of Separation from their Spring, Course, or Receptacle.

Article 14. What are the Appearances, and sensible Qualities, of the Waters upon being fresh taken up, in a clean Glass, from the Receptacle; and directly examin'd, by the Senses, at the Well-Head? Do they sparkle, or bubble in the Glass? What is their Smell, Taste, Colour, Coldness, Clearness, and Specifick Gravity?

17. The best way of prosecuting a physical Enquiry seems to be by beginning with the Examination of the sensible Qualities of the Subject; or, at first, using the direct Testimony of the Senses; and carrying that as far as it will go; but afterwards contriving, and using, particular Helps for the Senses; so as to bring those things before them, which wou'd not otherwise appear: whereby a much more intimate, and physical, knowledge of the Subject is procurable.

Article 15. How do the sensible Qualities of the Water alter by standing, at the Well-Head, in the same Glass, in the open Air, for some hours, or days?

18. Whilst the Water remains in its Spring, Channel, or Receptacle, it probably receives a greater

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Sect. H. *Articles of ENQUIRY.*

greater degree of Motion, than when contain'd in a Glass; and may here, therefore, have a greater opportunity of letting its grosser Parts fall to the bottom; and of suffering what may be called a natural Analysis, or Separation: whence it may be expected that some of the heavier Parts will now subside, and some of the lighter fly off, or quit the body of the Water; leaving it less brisk, or spirituous.

What Alterations does the Water undergo in length of Time? will it actually ferment, or putrefy, by long standing, unsecured, in the open Air; or when well sealed down in Glass-Bottles; and this either with the Motion of Carriage, or without? Article 16.

19. Care shou'd be taken to determine whether the Water will, any way, undergo a true Putrefaction, or Fermentation; so as to afford different Phænomena, manifest different Contents, or produce different Effects, from those it is found to have in its sound, or natural state.

What are the best Methods, hitherto known, and used, of taking up, preserving, and securing the Water for Transportation, and Carriage? And if these Methods are defective, how may they be improved? Article 17.

20. Under this Article will come to be consider'd the Ways of preparing, filling, corking, cementing, and packing of the Bottles; with the proper Seasons of the Year, and hours of the Day, or Night, fittest for the purpose.

What Effects have the greatest Degrees of the Summer's Heat, and the Winter's Cold, upon the Water? Article 18.

21. This

21. This Article tends to begin the Analysis of the Water; as it may shew what Parts are exhalable by Heat, or separable by Cold.

Article 19. *What Phenomena, or Alterations, does the Water manifest upon adding a suitable variety of Things to it; with a view to discover its Contents?*

22. This Article is of large extent; and requires to be prosecuted with diligence, and exactness. But the Foundation of the Procedure shou'd be laid down, and the Validity of the Experiments shewn, before any Conclusions are drawn from themⁱ.

Article 20. *What Substances are the Waters resolvable into, by an exact chemical Analysis?*

23. This Article, duly prosecuted, may prove eminently serviceable, or perhaps satisfactory, in the present Enquiry; as tending to shew both the volatile and fix'd Contents of the Water, in different Seasons; with their respective Proportions, Virtues, and Uses^k.

Article 21. *Wherein does this Water differ from other Mineral Waters, of kin thereto; suppose those of the German-Spaw, Pyrmont, Tunbridge, &c.*

24. This Article, relating to the Comparative History of the Water, shou'd be prosecuted till some remarkable, and essential Difference, or Correspondence, appears.

Article 22. *Can the Water be imitated by Art, or recomposed from its own separated Parts?*

25. The Answer here will have a great dependence upon the justness, or exactness, of the

ⁱ See hereafter, Sect. IV.

^k See below, Sect. IV, V.

Sect. II. *Articles of ENQUIRY.*

15

Analysis, and the Manner wherein the Imitation, or Recomposition, is attempted; which must be directed by the Light gain'd from the Enquiry.

III.

The Waters consider'd as a Medicine.

What are likely to be the medicinal Effects of the Article 23: Water, taken into the Body; judging from the Information gain'd by prosecuting the preceding Articles of Enquiry?

26. The Answer, in this Case, will be adequate, or inadequate, according to the Certainty, or Uncertainty, of the Discovery made of the Contents of the Water: whence the present, compared with the following Article, may shew how far that Part of the Enquiry has been just, or its Discoveries valid.

What are the medicinal Virtues of the Water, found Article 24: upon competent Experience, or Trial, by drinking them? And for the Cure, or Relief, of what Distempers are they adapted, or found serviceable?

27. Under this Article it may be proper to enquire whether the Water has any specifick Virtue, or Power of curing a certain Distemper, or Distempers, in a more easy, expeditious, or effectual manner, than any other known Water, or Remedy.

What are the physical Effects produced in the Body, Article 25: by drinking the Waters, for a competent Time, in a competent Quantity; so as clearly to manifest their Effects?

28. Thus, in particular, it may be enquired how they affect, or alter, the Blood, the Pulse, the

the Head, the Tongue, the Urine, &c. of the Drinkers.

- Article 26.* May the Use of the Water be extended to the Cure, or Relief, of any other Distempers, besides those it is drank for at present?
29. The Answer must here be derived from a knowledge of the Contents of the Water; its approved Virtues; and from its farther application, in new Cases.
- Article 27.* What Changes have hitherto happen'd in the Method of drinking the Water; and with what Advantages, or Disadvantages?
- Article 28.* Are any Errors committed in the present Method of drinking the Water? And, if there are, how may those Errors be corrected?
- Article 29.* Shou'd not different Methods of drinking the Water be introduced, suitable to the Nature of particular Distempers, Constitutions, and Ways of Living?
- Article 30.* What are the best Ways, hitherto known, of promoting the Operation of the Waters, suitably to the Distemper and Constitution? And shou'd they, in all Cases, be taken as an Evacuant, or not, sometimes, rather as an Alterant?
- Article 31.* What are the best Methods of preparing the Body, so as, in the shortest Time, to receive the full Benefit of the Waters; without hazard, or danger?
- Article 32.* Are any Correctives, or additional Remedies, proper to be used along with the Waters?
- Article 33.* How long shou'd the Waters be drank in different Cases; in what Quantities; and at what Intervals?

tervals ? Or, shou'd Medicines be interposed during the Course ?

What is the best and safest Dose of the Water, Article 34. to begin with ; how shou'd the Dose be increased ; and how long shou'd the Course be continued, with respect to the Disease, Constitution, Way of Living, Alteration of the Weather, or Season of the Year ?

Shou'd any Medicines be taken after the Course is finished ? Article 35.

What are the properest Seasons of the Year for drinking the Waters ? Article 36.

Is it proper to repeat the Course, for several Years successively, in some Cases ; or to intermit it, for a Year or two, and afterwards repeat it ? Article 37.

What Regimen, as to Diet, Exercise, &c. is best to be observ'd before, in, and after the Course ? Article 38.

What are the Signs that the Water suits the Case, and Constitution, of the Drinker ; whereby he may either be encouraged to proceed, or desist ? Article 39.

What are the Inconveniencies, or Disorders, known to happen, upon the first Days of drinking ; or during the Course, upon living irregularly, or taking the Water imprudently ? Article 40.

What difference is there, with regard to the Cure of Diseases, betwixt drinking the Water fresh, at the Well-Head ; or after it is carried a considerable distance from it ? And may not some Distempers require the one, and some the other ? Article 41.

What difference is there betwixt drinking the Water hot, or cold, with regard to different Diseases, Constitutions, and Ways of Living ? Or may not some Distempers require the one, and some the other ? Article 42.

Can the Water be warmed, without losing part of its Virtue ? If it can, how is this to be done ? Article 43.

Article 44. May the Waters be advantageously used at Meals; or mixed and drank with Wine, Milk, &c. in some Cases?

30. The eighteen preceding Articles plainly regard Practice, and Use; and shou'd therefore be carefully prosecuted.

Article 45. Are there not already known, or may there not, from the Enquiry, be derived, certain Ways of heightening the Virtues of the Water; so as to render it more effectual in the Cure, or Relief, of some obstinate Diseases?

31. Thus, for example, if the Virtue chiefly required in the Cure of any Distemper, shou'd be found to reside in the Salt of the Water; cou'd not this Salt be separated from a large proportion of the Water, and added to a small one; so as to heighten the Virtue of the Water? Or, cou'd not its Virtues be increased, in other respects, by the addition of certain Tinctures, Solutions, or Impregnations, of Mineral Matters, of the same nature with the Contents of the Water, found by the Enquiry?

Article 46. What are the Virtues of the Water, used externally, or in the Way of Bathing?

A P P E N D I X,

For receiving more Heads of Enquiry, whether they fall under the three preceding general Divisions, or not.

Article 47. What are the Family-Uses of the Water?

32. The meaning here is to enquire how far the Water may be serviceable in Washing, Brewing, the making of Tea, Coffee, &c.

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May not the Water be particularly useful to Apothecaries, Chemists, Dyers, Tanners, Vitriol-makers, Soap-boilers, &c.? Article 48.

Has the Sediment, Mud, or earthy Matter, of the Spring, any external, medicinal Use; as in the Cure of scrophulous Swellings, Cancers, &c. or any curious Uses in particular Arts, or Trades? Article 49.

Can any Intimations of a Mine, or useful mineral Substance, be gain'd from the Enquiry; or can any new Uses be made of the mineral Matters found near the Confines of the Spring? Article 50.

33. Thus we have given a Summary of the more necessary Heads we can, at present, think of, before an entrance is made into the Enquiry itself; where more may happen to turn up; and either occasion the number to be enlarged, or shew that it may be lessen'd, by reducing two, or more, Heads to one; and pursuing them jointly. —

S E C T. III.

Of the Instruments, and Apparatus, necessary to the ENQUIRY.

1. Before we enter upon the Enquiry itself, it will be necessary to collect together the principal Instruments, and Apparatus, proposed to be used therein; that the Work may afterwards proceed with less interruption. And this may be done; by running over the Heads of Enquiry already laid down; to see what Instruments, and Apparatus are there pointed out.

2. And first, the Mariner's Compass may be useful, in determining the Situation of the Well, and the Course of the Water to the Receptacle:

because the Needle of this Compass pointing North and South (excepting for the Variation) the Enquirer may thence be enabled to lay down with exactness, the Course, or Windings, of the Streams, and the respective Situation of the adjacent Towns, or Country.

3. For examining the Water itself, its Contents, and the mineral Substances found near the Confines of the Well, or Course of the Water, there will be required; (1) Exact Scales, and Weights; (2) An Hydrostatical Balance; (3) Variety of Glasses, common, and chemical; (4) Cements; (5) A Thermometer; (6) A Hand-Pump; (7) An Air-Pump; (8) Microscopes; (9) An armed Loadstone, or touched Plate of Iron; (10) Distill'd Water; (11) Crucibles; (12) A melting Furnace; (13) Fluxes, or Flux-Powders; (14) Various Vegetables; (15) Animal Matters; (16) Minerals; and (17) Artificial Substances.

4. (1) The Scales shou'd be of three sizes, all of them well made, for weighing Grains, Drams, and Ounces, or even a few Pounds: And the Weight employ'd shou'd be *Troy*, which is the medicinal, or Apothecaries, Weight; the Pound whereof is twelve Ounces; the Ounce divided into eight Drams, the Dram into three Scruples, and the Scruple into twenty Grains.

5. (2) The Hydrostatical Balance is an Instrument, or a certain Species of Scales, contrived to weigh Bodies in Water, so as to determine their specifick Gravity: as it also will do that of any mineral Water, by weighing a certain Glas-Bubble, therein, the weight of the Bubble, in the Air, and in common Water, being known before hand.

6. (3) The Glasses to be procured are (1) such as may commodiously exhibit the Water to the

Eye,

Sect. III. *Apparatus for the ENQUIRY.*

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Eye, and the Senses; and shou'd therefore be crystalline, and some of them cylindrical: (2) such as may bear Heat, and serve for Evaporation; these shou'd therefore be shallow, and widen upwards: (3) such as may confine the Water; as common Vials, Bottles, Glass-Eggs, and Bolt-Heads: and (4) such as may serve for Distillation; as Glass-Bodies, with Alembick-Heads, or Retorts and Receivers.

7. (4) By Cements are here meant those Matters, or artificial Compositions, which being applied to the Mouths of Glasses, tend to preserve the contain'd Water in a sound state, by keeping it from all communication with the external Air; such as melted Rosin, Sealing-Wax, or rather proper Mixtures of Wax, Turpentine, &c.

8. (5) A Thermometer is of use to determine the degree of warmth, or coldness, of the Water; being an Instrument consisting of a hollow Glass-Ball, with a long, and slender Neck, or Stem, filled to a certain height, with tinged Spirit of Wine; and divided into Degrees along the Stem; so as by the rising, or falling, of the Spirit of Wine therein, to shew the degree of Warmth, or Coolness, of any Fluid, wherein the Ball is placed.

9. (6) A small Hand-Pump, made either of Wood, or Tin, with its proper Embolus, or Sucker, is necessary to raise the Water immediately from near the Bottom of the Well; to shew whether this differs from that taken up near the upper Surface: tho' other Contrivances may also be used for this purpose.

10. (7) The Air-Pump, with its Glass Receivers, is a proper Instrument in helping to discover the proportion of Air, or volatile, fugitive Spirit, contain'd in the Water; for spiritu-

ous Waters are found to throw up, and discharge, a large quantity of Bubbles, when placed under the exhausted Receiver of the Air-Pump: and according to the greater or less number, and size, of the Bubbles thus discharged, the Water is judged to be more, or less, aerial, or spirituous.

11. (8) Microscopes, or Magnifying-Glasses, may be used in examining whether any visible component Particles can be found in a single Drop of the Water; but more successfully, perhaps, in determining the Figures of the Crystals, or Salts, of the Water, after Evaporation; or during the Time of Crystallization. It might also be proper to examine all the other solid, or visible, Contents of the Water, by the Microscope, both in a state of Mixture, and after they are separated from each other.

12. (9) The armed Loadstone, or touched Plate of Iron, is of use to discover whether any of the mineral Matters found near the Confines of the Well, or among the dry Contents of the Water, are of an irony nature: for whatever the armed Loadstone, or a touched Iron-Plate attracts, is generally allowed to be Iron. Tho' other Proofs of this, shou'd also be procured. And perhaps the Loadstone will not attract Iron in all States, and Circumstances; as unless it be pure, and perfect, or have all the Parts essential to malleable Iron: so that a mineral Substance may, possibly be irony, tho' the Loadstone shou'd not attract it.

13. (10) Distilled Water, or Water freed, as much as possible, from all mineral, saline, terrestrial, or other foreign Matters, is of use to discover the saline, or soluble, Contents of any mineral Substance, or dry Matter of a Mineral Water.

Water; by dissolving them from the less soluble parts, and giving them again, in a solid form, by Evaporation, or CrySTALLIZATION. The Water shou'd be pure for this purpose; otherwise it might mix its own mineral, or saline, Matters, along with those of the Matter proposed to be examined; and so render the Experiment fallacious, or uncertain. Now, there is scarce a better way known of procuring Water in purity, than by gentle Distillation, in clean Glass-Vessels.

14. (11) Crucibles, or melting-Pots, made of an earthy, or stony, matter, are useful in trying whether the dry Contents of a Water, or other mineral Substances, are metallick, or hold any considerable proportion of Metal: for if they do, the Metal may usually be got out of them, by powdering the Substance, and if necessary, mixing it with a proper Flux; then melting them together, in a strong Fire.

15. (12) A strong Fire is required to melt most metallick Substances; so as to separate the Metal from them; tho', in some Cases, a Wind-Furnace, that is, a melting Furnace, or Fire, animated barely with a current of Air, which it spontaneously draws to itself, is sufficient for this purpose. But where the Matter proves stubborn, or hard to melt, a Fire briskly agitated, or blown, with a pair of double Bellows, like those of the Silver-Smith, or Black-Smith, are usually required.

16. (13) Fluxes, or Flux-Powders, are any kind of Substance, which being added to a Mineral, or Ore, and melted therewith, causes it to run easier, and yield its Metal sooner, or in greater plenty, than it wou'd do when melted without addition. Thus Tartar, or Argol, Nitre, or Salt-Petre, Borax, Glass of Lead,

Iron-Filings, &c. are Fluxes; and shou'd be ready at hand, in order to the examination of the mineral Substances that may occur in the present Enquiry.

17. (14) Certain vegetable Matters are found to strike different Colours with different Liquors; and according to the Colour produced, an Indication is obtained of one, or more, particular Substances contained in a Liquor. Thus, if fresh Violets be suffer'd to stand, for some time, in a pellucid Mineral Water; and the Water should now appear of a red Colour; hence an Indication wou'd be gain'd that an Acid is predominant in the Water; but if a green Colour shou'd thus be produced, this denotes that an Alkali prevails in the Water; but if the Water retains the native blue Colour of the Violets; this shews, that the Water is neutral; or that neither an Acid, nor Alkali, prevails therein¹. The principal,

¹ By *Acid*, in the common Sense, is meant any Substance that tastes tart, or sour, as Tamarinds, Cream of Tartar, Sorrel, the Juice of Lemmons, Verjuice, Vinegar, Spirit of Sulphur, Spirit of Nitre, Oil of Vitriol, &c. By *Alkali*, in the same Sense, is meant any Substance that, being mixed with an Acid, lessens, takes off, or destroys the acidity; as Chalk, Limestone, Oyster-Shells, Crab's Eyes, the Earth of certain Mineral Waters, &c. or again, those called Alkaline Salts; as Salt of Tartar, Salt of Pot-ash, fixed Nitre; Salt of Hartshorn, Salt of Urine, &c. which, added in a sufficient Proportion, take off, or destroy, the acidity of Acids, and render the Mixture *neutral*; that is, of such a nature, or temper, as manifests no Signs of a prevailing Acid, or Alkali. And here let it be observed, that Acids, tho' they agree in the property of Acidity, may yet greatly differ from each other in other respects; as Vinegar and Lemon-Juice, Spirit of Nitre, and Oil of Vitriol, &c. And the same is to be understood of Alkalies, and Neutrals; which tho' they agree in being alkaline, or neutral, respectively; yet, in other Properties, they may differ as much as Alkali and Acid.

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therefore, of those vegetable Substances, which have the Faculty of indicating, by a change of Colour, the Contents of a Mineral Water, or other Liquor, shou'd be procured, and kept in readiness, for our purpose.

8. These vegetable Subjects, seem reducible to four Classes; viz. (1) Such as are Astringent, (2) of a fine Texture, (3) Purgative, and (4) Alterative.

9. (1) Among Astringents may be reckon'd Green-Tea, Oak-Leaves, Oak-Bark, Pomegranate-Bark, Balauftian-Flowers, Sumach, but, more particularly, Galls: all which are adapted to discover whether the Water be of an irony nature, or contain any Particles of Iron, or the Vitriol of Iron. And this they do by turning such Water purple, black or dusky; and, with time, precipitating a light, dusky Cloud, or inky Substance, to the bottom. The Galls, for this purpose, shou'd be of the blue, or strongest kind, sound, and newly reduced to Powder; which may be kept in a Glass close stopp'd. This Powder is used with greater dispatch, convenience, and exactness, than a Tincture of Galls made in Water, which weakens their Virtue. The Tincture, besides, loses of its tinging Faculty by keeping; and at the same time acquires a deep colour, which may disturb the Experiments.

20. (2) Under Vegetables of a fine Texture come the colour'd, or colouring ones, which have their Colours easily alter'd by simple Mixture; such as the Flowers of Red Roses, Mallows, Violets, Blue-Bottles, Clove-July-Flowers, *Lignum Nephriticum*, &c. which serve to indicate, by the change of Colour they produce in the Water, what kind of saline, or earthy,

earthy, Matters predominate therein. Thus, as was before observed, Violets turn a Water red where an Acid presides; and green where an Alkali; but communicate their own blue Colour where the Water is neither acid, nor alkaline. And thus, pure common Water being neither acid, nor alkaline, an Infusion of these Flowers therein exhibits a beautiful blue Colour. And as pure crystalline Sugar, also, is neither acid, nor alkaline, the addition thereof to the Infusion of these Flowers, introduces no change of Colour: whence the Syrup of Violets may be commodiously substituted for the Flowers, in the making of our Experiments.

21. (3) The Purgative Vegetables, of use in our Enquiry, are chiefly Sena, Rhubarb, Hermodactyls, Mechoacan, Jalap, &c. and this by the way of simple Infusion, Tincture, or Decoction, to discover some certain Contents, or solutive Powers, of the Water; but more particularly the Salts thereof: for alkaline Salts are found, in all Trials, to heighten the Tinctures, or Virtues, of these purgative Ingredients; or make the Water take up more of their Parts, especially if they be unctious, or resinous. Neutral Salts are also found to have the like effect, in a less degree; whilst acid ones are little disposed to open the Bodies of these Drugs, or make them yield strong Tinctures.

22. (4) Those commonly called the Alterative, or Drying, Woods, as Guaiacum, Sassafras, Saunders, &c. may be likewise serviceable in this Enquiry; and help to discover the Contents of the Water; as they will yield their Virtues to some Waters better than to others; particularly to such as abound with a Salt capable

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pable of dissolving their resinous, or unctuous Parts; wherein their medicinal Virtue principally appears to consist. And by this means also some new Uses of the Water may, probably, be discovered; viz. by applying it to the making of Infusions, Decoctions, or Extracts, of various Drugs, or Simples.

23. (15) It is of importance in the Enquiry to know how the Water affects the animal Fluids, or other animal Substances; as this may not only give Light into the Contents of the Water, but also afford Directions for its prudent use; and shew what effects may be rationally expected from drinking it. And here we shou'd principally regard the Changes it produces in the fresh extravasated Blood of a healthy Person; in coagulated, or dry, healthy human Blood; in the Serum of sound Blood; in morbid Blood of various kinds, as that of rheumatick, scorbutick, pleuretick, consumptive, hypochondriacal, and maniacal Persons; upon the *Calculus humanus*, or Stone of the Bladder; upon Gall-stones; upon the chalk-stones of Gouty Persons; upon Matter, or Pus; upon Urine, recent, stale, and gravelly, &c. upon viscid Phlegm, gellied Lympha, or other sound and morbid animal Substances; especially as assisted with a degree of Heat equal to that of the human Body.

24. (16) It may be proper to mix different kinds of Minerals with the Water, to try if any remarkable Changes can be thereby produced; or the Virtues of the Water increased; or its Contents the better discover'd. And, in this View, several Ores, especially the softer, or more soluble, sorts, might be used; especially Iron-Ore, Mundick, Marcasites, or the Pyrites; as also Lime-stone, Alum-stone, Vitriol,

Vitriol, Sulphur, and the mineral Salts. Any of these Matters, if made to dissolve in the Water, might produce considerable Changes therein; or increase its Virtues, if they depended upon Contents of the same kind. Thus, for example, if any part of the Virtue of the Water shou'd depend upon Iron, the artificial introduction of more Iron might heighten the Virtue of the Water. And so again, if Vitriol, Alum, or Sulphur, be naturally contain'd in the Water; these Minerals might be added to it, in a proper manner. So again, it may be proper to try whether pure Silver will change its colour, or turn black, in the Water; or whether Lead, Quicksilver, &c. will, any way, dissolve therein: whereby a knowledge may be gain'd of certain Contents, or Properties, of the Water.

25. (17) The Head of Artificial Substances might admit of great variety: but we will here single out the more necessary Particulars, under the Classes of (1) Alkalies; (2) Acids, and (3) Metallick Preparations, and Solutions.

26. (1) By Alkalies are here meant what the Chemists call'd fix'd and volatile alkaline Salts, and Spirits. Fix'd alkaline Salts are made by boiling the white Ashes of proper vegetable Subjects, such as common Billet-Wood, Bean-Stalks, Vine-Cuttings, Tartar, &c. in Water, to dissolve the Salt out of the Ashes; then evaporating the clear Solution, till a dry Salt be left behind. Salt of Tartar is a principal Salt of this kind, and has considerable uses in the examination of Mineral Waters: for as it dissolves more readily, and fully, in Water, than any earthy Substance; in proportion as it dissolves, the earthy Substance, contain'd in the Water, will fall to the bot-

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tom ; so that, by this Expedient, a large quantity of the Earth of a Mineral Water may be separated ; and made to assume a dry form. And as this Salt is alkaline ; if the Water be acid, some conflict, or ebullition, may be expected upon mixing them together : for this is commonly the case when an Acid and Alkali are mixed. Or, by a prudent addition of this Salt, so as just to take off the acidity of the Water, a neutral Salt may be made, and, by a proper Treatment, render'd sensible ; so as to afford a satisfactory Proof that the Water was acid. Salt of Tartar also readily runs, by the moisture of the Air, into a ponderous Liquid, called Oil of Tartar *per deliquium* ; which may often be used with greater convenience than the Salt itself ; as it is purer, more easily unites with Water, and may be more commodiously dropp'd into it. But if either the Earth, or Acid of a Water, shou'd be light, fine, or almost imperceptible ; so as not to manifest themselves upon the addition of a strong Alkali ; a milder sort may be required ; such as those called volatile alkaline Salts, or urinous Spirits ; viz. the Salts, or Spirits, of Hartshorn, Blood, Urine, &c.

7. (2) We must likewise be provided of those called mineral Acids, or artificial acid Spirits ; such as the Spirit, and Oil, of Vitriol ; Spirit of Sulphur, made by the Bell ; Spirit of Salt ; Spirit of Nitre, &c. for these Acids serve to discover whether the Water be alkaline. Thus, for example, as Oil of Vitriol is a very strong Acid, a drop, or two, whereof will communicate a perceptible acidity to four or five ounces of common Water ; if a drop, or two, of this Acid give no perceptible acidity to four or five ounces of a mineral Water ; it will hence appear

Apparatus for the ENQUIRY. Part

appear that the Mineral Water is alkaline; or impregnated with something that has a power to blunt Acids, or destroy, their acid nature, and turn them neutral. But where only light, or subtile, Alkali is contain'd in a Mineral Water, lighter Acids may be used for the purpose; such as Lemmon-Juice, distill'd Vinegar, *Rhenish* Wine, &c.

28. (3) The Metallick Solutions, or Preparations, usually made by Chemists, will be of considerable Service; not only as they may confirm the Conclusions drawn from other Experiments; but also discover still more of the Contents, and Properties of the Water. Some of the most necessary ones are the following, viz. (1) A Solution of Corrosive Sublimation in distill'd Water; (2) A Solution of pure Silver in *Aqua fortis*; (3) A Solution of Quick-silver in *Aqua fortis*; (4) A Solution of *Saccharum Saturni*, or Sugar of Lead, in Water; (5) A Solution of Gold, in *Aqua regia*; (6) A Solution of Copper, in *Aqua fortis*; and another of the same Metal, in Spirit of Salt ammoniac; (7) A Solution of Iron, in *Aqua fortis*; and another of the same Metal, in distill'd Vinegar, or any tart Wine: the uses of all which will appear in the Course of the Enquiry.

S E C T. IV.

Of the Experiments to be used in the ENQUIRY.

1. The Design of the present Section is to shew the possibility of making an exact, and satisfactory, Enquiry, into the Contents of a Mineral Water; for, till this also is shewn, we shall not be prepared to enter upon the Enquiry itself: as

Part IV. *The Experiments to be used.*

The Business of examining Mineral Waters has hitherto, that we know of, been reduced to the form of an Art; or brought under the Laws of physical Demonstration. Some Attempts, indeed, have been made in this way; but they are so imperfect as to leave many strong Objections upon the Minds of the major part of Naturalists, Physicians, and Chemists. The Reason appears to have been this; that the Experiments hitherto offer'd, for determining the contents of Mineral Waters, are generally slight, and superficial; or by no means, fully verified, and carried on, in the form of Induction.

2. By Induction we mean the Art of Enquiry, originally invented by the Lord Chancellor Bacon; and, in good measure, deliver'd by him, (who never perfected) in the second Book of his *Novum Organum*. This Art is no more than a rational, or scientific Method, of investigating, or tracing out, the Natures of Things; so as to manifest by what Laws, Means, or Actions, they physically exist, and produce their Effects. It appears in all respects to be the best, or most certain, if not the only true, Art hitherto known, of promoting physical Knowledge; provided it be practis'd with that Caution, and according to those Rules which itself delivers. The principal Uses of it are to shew what Method shou'd be observed; and what Experiments, or Observations, are to be made, in every Subject; how they are to be applied; what Particulars they bring to Light; or what Discoveries they afford: or does this Art obtain its End, till certain Axioms, or general Conclusions, are formed, by its means; comprehending the Nature of the Subject, and directing to an extensive Practice upon it. This Art, therefore, consists in a prudent, and suitable use of the Invention, the Memory, Reason.

Reasoning, and Experiment, all improved and assisted to the utmost ; where Invention directs the Articles of Enquiry, Reasoning directs the Experiments, and the Experiments when made, inform and farther direct the Invention, and the Reason ; so as to point on other Experiments, till the Nature of the Subject is fully discover'd. Thus, in the present Undertaking, this Art has directed the Invention, the Reason, and the Memory, to call about, and suggest, the first Heads of Enquiry and the Experiments to be made ; but can proceed no farther till the Experiments themselves are made ; or the Answers gain'd, from Nature to the Questions propos'd ; after which, the Reason, from the new Light acquired, may direct farther Experiments, till thus the Enquiry is brought to a Conclusion.

3. The present Business is, therefore, to explain the Nature of the Experiments, already pointed out by our Articles of Enquiry ; with the Way of conducting them, according to the Art abovementioned ; that they may give a clear and just Information ; and not lead us into Error, and Confusion. But to do this in the amplest, and most satisfactory Manner, wou'd require an exactness, or scrupulousness, of Procedure which might disgust any but mathematical Readers ; and draw us into a Length unsuitable to the present Design. Tho' as the Thing is of the utmost importance, not only to the present Enquiry, but likewise to all others of the like kind ; it may be proper to dwell a little upon it ; with a view to shew, by way of Example, what Rigour is required, and what Evidence or Proofs, may be had, in physical Enquiries and the Examination of Mineral Waters.

4. The End of our present Enquiry is to discover the Contents, Virtues, and Uses, of a certain Mineral Water; but as the Virtues, and Uses of this Water must necessarily depend upon its Contents, Ingredients, or the Parts whereof it consists; the principal Drift, and Scope, of the Enquiry must be to discover, or, as far as possible, to manifest these Contents, and bring them under the Cognizance of the Senses, or Reason.

5. And here it comes first to be consider'd, from the apparent Nature of the Thing; and from some knowledge of the Properties of common Water, and the Substances capable of dissolving therein; with what kinds of Matters the present Mineral Water is likely to be impregnated. Now it is self-evident, that the Contents of every Water must be such as are capable of lodging therein, without hindering its transparency; and without giving it Properties different from those found in it by the Senses, or particular Experiments; otherwise it would not be the Water it is.

6. Mineral Waters are generally understood to be those running Waters, which receive any remarkable Quality, or Property, in the Earth, whereby they differ from common Water; and whence become either more beneficial than that, in the Cure, or Relief of certain Diseases, or else more noxious, or prejudicial to the Body. By which Definition, the Contents of Mineral Waters, seem, as the name imports, limited to Subjects of the Mineral Kingdom. But as just Definitions can never be given, till the Natures of Things are discover'd, we shall make no farther use of the present one, than to direct our Enquiry, more particularly, to the discovery of Mineral Matters in the Water; the without
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neglecting such as may be of a vegetable, or animal, nature. For, as vegetable, and animal Matters plentifully abound in the Earth, and may lie in the Course, or Confines, of a Spring; it is not impossible that certain parts thereof shou'd, at some times, or in some places, mix with the Water.

7. But, to shorten our present Labour, it may be proper to contract our View, and here limit ourselves to such Things only, as Water is commonly known to dissolve; and such as have been found, by competent Trials, to exist in Mineral Waters: for we do not here undertake to write a System of natural, and chemical Philosophy; but to shew the Way of pursuing a particular Enquiry into Mineral Waters, by means of suitable Experiments.

8. The Bodies capable of permanently dissolving in Water, without hindering its transparency, and such as have been found to exist in Mineral Waters, seem reducible to four Classes; viz. (1) *Salts*; (2) *Earths*; (3) *Sulphurs*; and (4) *Fumes, or Spirits*. Now, the Question here is, whether natural Philosophy, and Chemistry, even in their present States, may not supply Ways of discovering, with physical Certainty, if any of these are, or are not, contain'd in a Mineral Water. From several Observations and Experiments, which we have ourselves made, and some also that we have read, we incline to think this possible; and now proceed to lay down the Ways wherein we judge it may be effected.

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9. All true Salts dissolve in Water; this being one of their essential Properties, or Characteristics; and as there are few Mineral Wa-

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ters but what, upon a common Analysis, are found to contain a saline Substance; and as the principal Virtue of these Waters is sometimes found to reside therein; a primary regard shou'd be had to discover, whether a proposed Mineral Water contains any Salt; to determine the Species thereof, if known, assign its proportion to the Water, or to the other Ingredients; describe its particular Properties, Virtues, and Uses; and produce, or exhibit, such Salt, or Salts, in their natural, or true form; and appearance.

10. The natural Mineral Salts, or Salts supposed to be Mineral, are (1) Sea-Salt, or common Salt, (2) Nitre, (3) Alum, (4) Borax, (5) Sal-Ammoniac, (6) Epsom Salt, or the *Sal Catharticum amarum*, (7) Dr. Lister's *Nitrum Martiale*, or Calcarious Nitre, (8) The universal Acid, and (9) The mineral alkaline Salt.

(1) SEA-SALT:

11. In order to discover whether Sea-Salt, or any other known Salt, be naturally contained in a Mineral Water, it is previously necessary to be acquainted with the Natures, and Properties, of these Salts; otherwise we might be at a loss to know them, when they come in our way.

12. Some of the chief Properties of Sea-Salt, as distinguish'd from all other known Salts, seem to be these; viz. (1) Its particular appearance; its saline taste; and its form, being either that of Grains; or cubical Crystals, when true shot. (2) Its preserving Quality; especially with regard to animal Flesh. (3) Its manner of decrepitating, or crackling, in, or over, the Fire; and increasing the strength thereof, when sprinkled upon live Coals. (4) The particular Odour

it yields in this Decrepitation; being that of the Spirit of Salt. (5) Its affording the true Spirit of Salt, in a dense, white, pungent Vapour, by Distillation; which Spirit, as well as the Salt in substance, turns *Aqua fortis* into *Aqua regia*, and thus makes a Solvent for Gold. (6) Its melting with difficulty, in a strong Fire; and at length passing thro' the Pores of the Crucible. (7) Its being recoverable from its own Spirit, by the addition of any pure and fix'd alkaline Salt. (8) Its Spirit constituting Sal-ammoniac with any volatile Alkali; or the Salt itself affording Sal-ammoniac, by Sublimation, after being digested with Urine. (9) Its remaining dissolved by common Water, in the proportion of about six ounces to a Pint. And (10) its faculty of precipitating Silver dissolved in *Aqua fortis*; so as to increase the weight of the Silver, and render it volatile in a strong Fire. A previous knowledge of these Properties of Sea-Salt may sufficiently enable us to discover it in a Mineral Water; or under whatever form, or disguise, it may happen to be met with.

13. The known Ways of discovering whether Sea-Salt be contain'd in a Water, seem reducible to these three; viz. (1) Addition to the Water; (2) Evaporation, and Addition to the dry Matter; and (3) Crystallization.

(1) *By Addition to the Water.*

14. *Case I.*] To two ounces of pure distill'd common Water, contain'd in a white, crystalline, cylindrical Glass, add, drop by drop, four Grains of a pellucid Solution of Silver, made in *Aqua fortis*, with one ounce of refined Silver to four ounces of proof *Aqua fortis*; and no Milkiness, Cloudiness, Change of Colour, or Transparency will appear in the Water.

15. *Case II.*]

15. *Case II.*] To two ounces of the same distill'd Water add a single Grain of Sea-Salt, let it perfectly dissolve therein, by stirring the whole together with a clean Glass Rod; and now dropping in four Grains of the same Solution of Silver, a manifest Milkiness, or white Cloudiness, will appear in the Water, or a white Precipitate fall to the bottom of the Glass.

16. " Now, as nothing was added in the second Case, more than in the first, besides a single Grain of Sea-Salt; it is manifest that the Solution of Silver, by causing a Milkiness, or white Precipitate, gives an Indication of the Sea-Salt added to the Water in the second Case. Therefore, when such a Solution of Silver causes no change in a suitable proportion of a Water; it may hence be suspected that the Water contains extremely little, or no Sea-Salt; but if a Milkiness, or white Precipitate ensues, that some proportion of Sea-Salt is lodged therein."

17. " The Chemical Reason of the Experiment is this; that Silver remains permanently dissolved in its proper Menstruum, *Aqua fortis*; and by no means so in the Solvent of Gold, or *Aqua regia*; which will not touch Silver, but constantly precipitates it from its own Solvent *Aqua fortis*, on account of the Sea-Salt, or Spirit of Sea-Salt, contain'd in *Aqua regia*; which constitutes the sole difference betwixt the two Menstruums. And, therefore, when a Solution of Silver, made in *Aqua fortis*, is added to pure distill'd Water, which contains no Sea-Salt, it mixes intimately therewith; the Silver here also remaining transparently dissolved, and equally suspended, and dispersed thro'

The Experiments to be used. VI Part I.

the whole. But upon the addition of Sea-Salt, which turns the Liquor into an *Aqua regia*, the Silver is immediately set loose, the Mixture grows white, or milky; and lets the Silver fall, according to its nature, in a white Powder, or Precipitate, to the bottom.

18. *Case III.*] To the like quantities of the same Water, contain'd in several Glasses, separately add a Grain of pure Nitre, pure Alum, and pure Borax; in all which there is no mixture of Sea-Salt; and into each Glas let fall the Solution of Silver, as before; upon which no change of Colour, or Transparency, will ensue; nor any Precipitation be made. And this appears to hold of all the Salts wherein no Sea-Salt is contained.

19. *Case IV.*] Mix together, in a clean Glas Mortar, equal, or unequal, parts of pure Nitre, pure Borax, and pure Alum, wherein there is no Sea-Salt lodged; put four Grains of this Mixture into two ounces of the distill'd Water; let the whole entirely dissolve therein; then add the Solution of Silver, as before, and still no Milkiness, or Precipitation, like that in the second Case, will appear. And this also seems to hold of any Mixture of Salts, provided there be no Sea-Salt among them.

20. These four Cases, when duly consider'd, and compared, will shew that a Solution of Silver, in *Aqua fortis*, is a ready, an exact, and commodious Thing, for intimating whether there be, or be not, any considerable, or even minute, proportion of Sea-Salt contain'd in a Water. The same may likewise be done by a Solution of Quick-silver, in *Aqua fortis*, or an aqueous Solution of Sugar of Lead; tho' not in so exquisite,

“quisite, and perfect, a manner. This kind
“of Proof, may sometimes, indeed, happen
“to be fallacious, incompetent, or insuffi-
“cient; because other Salts, or Substances,
“whose natures and properties, are not hi-
“therto known, may possibly be able to
“precipitate Silver in Solution, as well as
“Sea-Salt does. Whence such kind of Tri-
“als shou’d not be proposed as demonstra-
“tive; but only as probable. All the In-
“ference, therefore, to be justly made from
“them, before they are otherwise verified, or
“confirm’d, is, that, since it must, with re-
“gard to the truth of the Experiment, be the
“same thing whether Sea-Salt is added to a
“Water by Nature, by Accident, or the
“Hand of Man, provided it be in the Wa-
“ter; we may hence be furnished with a
“probable Indication whether any Sea-Salt,
“even in a small proportion, be contain’d in
“a Water, or not. We now proceed to
“more direct, and infallible Proofs.”

(2) *By Evaporation, and Addition to the dry Matter.*

21. *Case I.*] To half a Pint of distill’d common Water add a Dram, or two, of Sea-Salt; which being totally dissolved therein, evaporate the Solution, over a clear Fire, till a dry Matter remains at the bottom. This dry Matter will, upon all Trials, be found to be Sea-Salt. Thus, for example, lay a part of it upon a piece of clean Glass, and add to it a few drops of well rectified Oil of Vitriol; and a considerable Heat, and Ebullition, will ensue; and a particular, white, pungent, Vapour, or Steam, arise, having the exact Smell of *Glauber’s* strong Spirit of Sea-Salt. Now, as no other Salt, unless it contains Sea-Salt, or

The Experiments to be used. Part I.

the Spirit of Sea-Salt, is found, upon the like Experiment, to afford this particular Vapour, and Odour; we have hence a clear Indication that Sea-Salt was contain'd in the dry Matter. And by adding a sufficient proportion of distill'd Water to this Matter, then evaporating the Solution, the Salt may be easily recover'd in its own pristine form.

22. *Case II.*] As Nitre, and Sea-Salt, may happen to be mix'd in a Water; and as both of them afford their respective Vapours, or Spirits, upon contact with Oil of Vitriol; dissolve equal parts of these two Salts in distill'd Water, and exhaling the superfluous Moisture, put the dry Matter into a Retort; and adding Oil of Vitriol to it, distil, in a Sand-Heat; whereby a true *Aqua regia* will be obtain'd; that is a Mixture of the Spirit of Nitre, and the Spirit of Sea-Salt; both which Spirits are thus made to rise in Vapour, and come over, mix'd, into the Receiver: whence we have a clear Indication that both Sea-Salt and Nitre were contain'd in the Mixture; since no other Matters, besides these two, in conjunction, are found to afford the true *Aqua regia*.

23. *Case III.*] Mix together equal, or unequal quantities of Sea-Salt, Salt of Tartar, *Epsom* Salt, Borax, and Alum; add a proper proportion of Oil of Vitriol thereto; and the peculiar, white, pungent Vapour of Sea-Salt will immediately arise, and give a plain Indication that Sea-Salt was contain'd in the Mixture. And this appears to hold of any other Mixture of different Salts with Sea-Salt; excepting Nitre, whose Mixture with Sea-Salt was consider'd under the second Case: for Nitre upon contact with Oil of Vitriol, yields

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its own peculiar Vapour, or the Fume of Spirit of Nitre; easily distinguishable from all others.

4. *Case IV.*] Mix together equal, or unequal, parts of Sea-Salt, Bole *Armeniac*, Chalk, and Brick-dust; then pouring Oil of Vitriol there-to, the peculiar Vapour, and Odour, of the Spirit of Sea-Salt, may still be remarkably observed, and distinguish'd. And this Experiment, also, appears to hold of the Mixture of Sea-Salt with any other stony, earthy, or mineral Substances.

5. " If this kind of Proof, depending upon
" the knowledge of the Smell, and Appearance,
" of a certain Fume, or Vapour, thou'd
" be thought precarious, or inconclusive; as
" it may be by those who are unacquainted
" with the peculiar Sensation constantly im-
" press'd by the Fume, or Spirit, of Sea-Salt,
" striking the Nostrils of any Person who has
" his Smell; the Experiment may be farther
" prosecuted, and render'd more satisfactory,
" and conclusive: for if the Mixtures afford-
" ing this Odour, be distill'd, in a Glass Re-
" tort, and Receiver, with a sufficient quan-
" tity of Oil of Vitriol, they will afford the
" true Spirit of Sea-Salt, according to all
" Trials; and particularly by this, that it is
" convertible into Sea-Salt again, by the
" proper addition of any fix'd alkaline Salt."

6. " The Chemical Foundation, whereon the
" Success of these Experiments, with Oil of
" Vitriol, depends, is this; that Oil of Vi-
" triol, being a strong Acid, and powerfully
" disposed to act upon Sea-Salt, and Nitre,
" so as to enter forcibly into their more fix'd,
" or gross, parts; at the same time that this
" is done, their lighter, or more volatile
" parts,

“ parts, are loosed from their connection with
 “ the grosser, and left free to rise, according
 “ to their lighter nature; and thus in proper
 “ distilling Vessels, come totally over the
 “ Helm, with the assistance of Heat; leaving
 “ the more ponderous, and terrestrial, Matter
 “ behind, closely united with the Oil of Vi-
 “ triol; as we see in the distillation of *Glauber's*
 “ strong Spirit of Sea-Salt, and Spirit of
 “ Nitre.”

(3) *By Crystallization.*

27. *Case I.*] Dissolve any proportion of Sea-Salt
 in distill'd Water; evaporate the Solution till
 a Film, or Skin, appears on the Surface; then
 put the Liquor into a clean, earthen Vessel;
 set it to shoot in a cool Place; and in a few
 days time, great part of the Salt will be found
 grain'd; or if the Solution were not too high
 boiled, and a sufficient time was afforded, shoot
 into Crystals, of a cubical figure.
28. *Case II.*] Mix equal, or unequal, Parts of
 Sea-Salt, Nitre, and *Epsom* Salt, by grinding
 them together in a clean Mortar; dissolve the
 whole in distill'd Water; evaporate the So-
 lution over a clear Fire, till a Film ap-
 pears on the Surface; then set the Liquor in a
 cool place for some days, and the Nitre will
 be found to shoot first, in its natural Crystals;
 which being taken out, and the remaining Li-
 quor again boiled, to a proper height, and
 exposed to shoot, as before; the Sea-Salt
 will be next obtained, in its own peculiar
 Grains, or Crystals. And if the Experiment
 be carried farther, by boiling the Liquor again,
 and setting it to shoot, the *Epsom* Salt will
 likewise be obtained. In the same manner may
 any Mixture of different Salts be separated,

each

IV. *The Experiments to be used.*

each in its own particular form, or Crystals. The Rule in Crystallization is this, that the Salt which dissolves most copiously in Water, shoots first out of the Mixture; and that which dissolves the most sparingly, first; whence Nitre shoots before Sea-Salt, and Sea-Salt before *Epsom Salt*.

9. " This last Method of Trial, by Crystallization, may of itself be esteem'd certain, or satisfactory; but joined with the two former, by Addition to the Water, and by Evaporation, and Addition to the dry Matter, it amounts to a physical Demonstration: so that where they all agree there can be no doubt that Sea-Salt is contained in a Mineral Water, treated after the same Manner: for the first affords an Intimation that this Salt is naturally contained in the Water; the second shews that it remains after Evaporation; and the third that it is actually separable, in its own proper form, from the Water; and may in this State be fairly examin'd, to try whether it has, or has not the known Properties of Sea-Salt. If any Scruple, or Suspicion, shou'd remain, as to its being Sea-Salt, let it be strictly compared with a parcel allow'd to be Sea-Salt, in all respects, according to the Characteristicks above given of this Salt; and if no difference appears betwixt the two, they must, at least be acknowledged of the same kind."

30. " It might, indeed, be here objected, that though Sea-Salt shou'd be contain'd in a Water, yet Nature may have so intimately, or, as it were, undistinguishably, and inseparably, blended or mix'd, it in with the Water, or other Contents, as not to mani-
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“ left itself upon the severest Trials; as fix
 “ alkaline Salt is concealed in Glass, Acid
 “ Flint, or Sulphur and Mercury in Metals
 “ or as other Principles are in those emphat-
 “ tically called Mixts, to distinguish them
 “ from Aggregates, or Compounds, where
 “ the Texture is loose, and the Parts more
 “ more easily separated. And this Objection
 “ must be allow’d of force, in some Cases
 “ till we can shew that even these Mixts can
 “ be separated by Art, or have their Ingre-
 “ dients render’d cognizable by the Senses
 “ or the Reason. This, indeed, belongs to
 “ a higher Chemistry than we are at present
 “ concern’d with; otherwise it might be
 “ made appear that Mixts, with regard to
 “ their Analysis, differ not from Compounds
 “ provided we were furnish’d with suitable
 “ analysing Powers, Instruments, and Men-
 “ struums. Thus Glass may be, without
 “ much difficulty, separated into the Sand
 “ and fix’d Salt that compose it; and Flint
 “ have their Acid separated from them, in
 “ the making of Glass; as we see in that
 “ Substance called, at the Glass-Houses, San-
 “ diver; and even the purer Metals may be
 “ analysed by the Burning-Glass, and other-
 “ wise: But there is no occasion to go thus
 “ far for an answer to the present Objection,
 “ in the Case of Mineral Waters, till it can
 “ be shewn that Nature has made any such
 “ firm Mixtures, as those abovementioned, in
 “ Mineral Waters: on the Contrary, nu-
 “ merous Experiments shew that the Prin-
 “ ciples here lie loose, and may be separated,
 “ by ordinary Means, to such a degree of
 “ Simplicity as clearly to manifest their
 “ physical, and medicinal Effects, Virtues,
 “ and

and Uses; wherein our present Enquiry centers. We therefore, presume that the preceding Experiments duly applied, and consider'd, furnish us with a sure Method to discover whether any Mineral Water contains Sea-Salt, and if it does, to separate it from all other Things; render it sensible, and determine its proportion."

"We have been the fuller upon this first Article of Sea-Salt, to shew an Example of the inductive Method which we would recommend in Experiments, and particularly in prosecuting Enquiries of this kind; where the Foundations of physical Certainty have scarce hitherto been laid. And, hoping there may be enough done in this strict Way, to shew the Nature of the Procedure intended, we shall, for fear of being thought too minute, and tedious, by frequently and circumstantially, repeating the same kind of Experiments, endeavour to dispatch the remaining Part in a more concise, and summary Manner."

II. N I T R E.

32. The Characteristicks of pure Nitre, or salt-Petre, seem to be chiefly these: viz. (1) Its peculiar form, or hexagonal, prismatick Crystals; pyramidal at one end, when the shoots are true, and perfect. (2) Its particular sharp, or penetrating, cool, and lightly bitterish taste. (3) Its preserving Flesh; and at the same time giving it a particular florid, or rosy Colour: whereto may be added its improving the red Colour of the Blood; especially when inclined to be white, black, or fizy. (4) Its cooling the Body, and lowering the Pulse; more remarkably in Fevers, and Pleurifies. (5) Its yielding a red, suffoca-

suffocating Fume, or Vapour, in distillation and thus affording a true *Aqua fortis*, or Spirit of Nitre, which is a Solvent for Silver, but not of itself for Gold. (6) Its manner of flowing or melting, in a Crucible, in the Fire; which is quick, and igneous; tho' this Salt does not itself take Flame, in the strongest Heat. (7) Its fulminating, and turning to a fix'd alkaline Salt, in Fusion, upon the addition of Charcoal, Tarrar, &c. with a considerable loss of weight. (8) Its composing Gunpowder with common Brimstone, and Charcoal. (9) Its being resolvable from its own acid Spirit, by the proper addition of any fix'd, alkaline Salt.

33. These Properties of Nitre being laid down, it is easy to try, if any Salt, supposed to be nitrous, whether found in a Mineral Water, or otherwise, be real Nitre, or not. And here it is manifest that by Nitre, or Salt-Petre, we do not mean the *Nitrum Mirale*, or calcareous Nitre, of Dr. Lister; whose Properties we hereafter be deliver'd; nor the Nitre of the Ancients, which appears to have been a very different Thing, of an alkaline nature; but our common, refined, Salt-Petre, used in Medicine, Chemistry, and the making of Gun-powder, being a neutral Salt, with regard to Alkali, and Acid; tho' resolvable, by Fire, and proper Additions, into a strong Alkali, and a strong Acid.

34. The Ways of discovering whether the Nitre be contain'd in a Water, seem reducible to four; viz. (1) by Immersion, or Steeping certain Bodies in the Water; (2) By Evaporation, and Addition to the dry Matter; (3) By Distillation, with Additions; and (4) by Crystallization.

(1) By Immersion, or Steeping.

5. If a little Nitre be dissolved in distill'd Water, and Paper be steep'd a while in the Solution, then dried before the Fire; and if there be occasion, dipp'd, and dried again; the Paper being now applied to a lighted Candle, or glowing Coal, will immediately take Fire, tho' not flame; and burn, like Quick-match, in a certain sparkling manner; so as to give a manifest Sign that it receiv'd this Property from Salt-Petre: for Paper steep'd in the like Solutions of Alum, Epsom-Salt, fix'd alkaline Salts, Vitriol, Borax, Nitrum murale, Sea-Salt, or any other of the known Salts, will not produce the same Phænomenon. Whence, if Paper, several times steep'd in a Mineral Water, shou'd produce this Effect, or burn after the same particular manner; this wou'd be an Indication that the Water contain'd Nitre.

6. The Reason of the Experiment scarce needs to be mentioned, as it is obvious, that the Paper by being soaked in the Solution, becomes impregnated with the Water, and of course Particles of the Salt; and being afterwards dried, the aqueous Parts thus exhale, and leave the particles of the Salt sticking in the Pores of the Paper; which being now applied to the Candle, it takes fire, and burns, or makes little fiery explosions, according to the well known property of Nitre; when mix'd, and fulminated, with any inflammable Substance. But as this Effect may possibly be prevented, or not so remarkably follow, if other Salts shou'd happen to be mix'd, in too large a proportion, along with the Nitre; the

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The Experiments to be used. 7 Part

“ following Case may help us to discover Nitre where it is blended with other Salts.”

37. If equal, or unequal, quantities of Nitre, Sea-Salt, Epsom Salt, and Borax, be dissolved in distill'd Water, and a piece of raw flesh steeped in the Solution for some hours, and then taken out and examin'd, or compared with a piece of the same raw Flesh, which has not undergone the same Operation, the former will be found redder than the latter, or than another piece of the same Flesh, so steeped, for the same time, in a Solution of the several Salts abovemention'd, except Nitre: whence it follows, that Nitre, according to its known property, was the Cause of this additional Redness. If, therefore, Mineral Water shou'd have the same Effect upon raw Flesh steep'd therein, we may presume that the Water contains Nitre.

38. “ It shou'd seem that Nitre gives this particular red, or rosy, Colour to raw Flesh on account of some of the Blood still remaining therein: for Nitre acts powerfully upon Blood: so as to brighten its Colour, and long preserve it fresh, and sound, even when stagnant, or extravasated. But to determine this Matter, it might be proper to try, whether a Muscle, so well washed and cleansed, from its Blood, (by soaking in fair Water, by Injections into the Blood Vessels, or otherwise) as to appear white, cou'd have any degree of redness restor'd it by Nitre; or whether it will turn a Tendon or other white animal Substance red.”

“ This Experiment shou'd be made with a proportion of Nitre, along with the Water: the proportion being such, as to restore the redness to the Muscle, or other white animal Substance, which has been washed and cleansed from its Blood.”

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(2) *By Evaporation, and Addition to the dry Matter.*

39. If Nitre be dissolved in Water, and the Solution evaporated to dryness, the Nitre will remain behind; and may be proved to be Nitre, by mixing it with powder'd Charcoal, and trying if it will fulminate, and turn to an alkaline Salt, in the Fire; if it will make Gunpowder with Brimstone and Willow Coal; or if it will afford the peculiar red Fume of a particular, nauseous, suffocating odour, like that of *Aqua fortis*, by pouring Oil of Vitriol to it. And, in the same manner, tho' Nitre shou'd be mix'd with several other Salts, in a Water; after Evaporation to a dry Substance, Indications may be gain'd of its being among them; but particularly by adding Oil of Vitriol to the compound Mass, and observing, and examining, the Fume, and Odour, thence arising.

(3) *By Distillation.*

40. So again, if Nitre, after the full Evaporation of any Water, remains mix'd among the dry Matter, it may be discover'd, by adding either Oil of Vitriol, calcined Vitriol, or Brickdust, thereto; and distilling, in a naked Fire; for thus the Nitre parting easily with its Spirit, this Spirit will soon rise, and come over, in red Fumes, into the Receiver. Only, if Sea-Salt happens to be in the Mixture, there may thus be obtain'd an *Aqua regia*, instead of a pure Spirit of Nitre; tho' this also gives a sufficient Indication of the Nitre; as *Aqua regia* cannot be made without the Spirit of Nitre. To carry the Proof farther, let trial be made whether, by adding a sufficient proportion

portion of any fix'd alkaline Salt, to the Spirit thus procured, true Nitre may not be recover'd; and whether this Nitre, in particular, will not serve in the making of Gunpowder; because it has been suspected that regenerated Nitre will not.

(4) *By Crystallization.*

41. It need not be mention'd, after what has been said before, of Crystallization, that a simple Solution of Nitre in Water, being brought to a due height, and set in a cool place, will in a few days, shoot into hexagonal, prismatick Crystals of pure Nitre. So that, if any Mineral Water shou'd contain no Salt but Nitre, this may easily be obtain'd from it, by a proper Evaporation, and subsequent Crystallization. Again, tho' several other Salts, besides Nitre, shou'd be contain'd in a Water, they may, by repeated Evaporations, and Crystallizations, be made to shoot separate, and thus be obtain'd pure, each in the Shoots or Crystals peculiar to itself; according to what was above deliver'd, under the Article Crystallization with regard to Sea Salt. And in this Manner therefore, Nitre may be obtain'd pure, and free from the admixture of any other Salt, which may happen to be contain'd in a Mineral Water.

42. " It will here be proper to remember, that
 " nitrous, or other saline Matters may possibly
 " sibly be contain'd in Mineral Waters, and
 " yet not be brought to appear in a solid
 " or true crystalline form, without some particular
 " ticular Encheiresis, or Expedient, suited to
 " the purpose. Thus, it is a constant Practice
 " at the Salt-Petre Works, to use a fixed, alkaline
 " kaline Salt, in order to consolidate,

embody the Nitre, and make it shoot firm, strong, and regular. The Cause appears to be this, that the Matters capable of affording such firm and solid Salts; are usually, of themselves, too acid; for many acid Matters are little disposed to shoot, and form themselves into solid, and hard Crystals; but, to fit them for this purpose, require to have their prevailing acidity destroy'd, and the whole Substance brought to a neutral State, by means of fixed, alkaline Salts; or terrestrial Alkalies; as we see in the making not only of Salt-Petre; but also of Loaf-Sugar, Alum, the artificial neutral Salts, &c. And these several Experiments, and Observations, properly applied, extended, and varied, may afford us a Method of discovering, with physical Certainty, whether Nitre be contain'd in a Mineral Water, or not."

III. A L U M.

43. The more essential Properties of Alum, so far as they are hitherto known, seem to be principally these; viz. (1) Its peculiar Figure, or the Form of its Crystals, which consist of eleven plain Sides, five of them sexangular, and six quadrangular. (2) Its peculiar sharp, rough, styptick, or astringent Taste. (3) Its melting aqueous over a soft Fire, and rising in a Blister; but, at length turning to a white, light, spongy, Substance, call'd burnt Alum. (4) Its affording when burnt, an acid Spirit, somewhat like Oil of Vitriol, by being distill'd, in a strong Fire, even without Addition. (5) This Spirit constituting Alum again, by being properly united with any fix'd, alkaline Salt. (6) Its particular Uses in striking, and fixing, certain Colours,

lours, along with other Ingredients; as we see in the Art of Dying, Leather-Dressing, the making of Red-Inks, &c. (7) Its being the only Salt, that, with suitable animals, or vegetable, Substances, will make the Black Phosphorus^m. (8) Its near affinity with Vitriol freed from the metallick part it contains. (9) Its serving, like Vitriol, in obtaining the common kinds of *Aqua fortis*, from Nitre.

44. The more satisfactory Ways of discovering whether Alum be contain'd in a Mineral Water, seem reducible to three; viz. (1) by the Taste; (2) by Evaporation, and treating the dry Matter; and (3) by Crystallization.

(1) *By the Taste.*

45. It is easy to distinguish, by the Taste, any considerable Proportion of Alum dissolved in Water; but if the Proportion shou'd be very minute, part of the Water may be exhale'd, and the Remainder tasted; for Alum will not evaporate by being boiled in Water; so that thus the Proportion may be greatly increased, till at length, if there be any of this Salt in the Water, it will come to be perceiv'd by the Taste. And this Case may often hold, tho' other Salts, besides Alum, should happen to be lodged in the Water; such as *Epsom* Salt, Nitre, fix'd alkaline Salt, &c. But the Salts, or other Substances, which mix'd with Alum, in a Mineral Water, seem the most likely to confound the Taste, or prevent its perceiv- ing the Alum, are Sea-Salt, Acid, Vitriol,

^m The black Phosphorus is a black Powder now usually made with Wheat-Flour, and Alum, mixed together, in a certain proportion, and calcined to a certain degree, till it requires the Property of taking Fire spontaneously, in the open Air, and appearing like a glowing Coal. —

styptick irony Earths, Chalk, or Limestone, corroded, and dissolved by an Acid, or otherwise ; so that tho' a Water actually contains Alum, yet the Taste shall not, with certainty, discover it : whence recourse must be had to particular Experiments, more subtile, and exquisite, than the Taste. We cannot, at present, suggest, or recollect, any satisfactory Experiment for determining, by addition to the Water, whether Alum, either alone, or mix'd with other Salts, be contained in a Mineral Water ; tho' the Plant called *ragged Robert*, is said peculiarly to turn any Water red wherein Alum is dissolved.

(2) *By Evaporation, and treating the dry Matter.*

46. When Alum is the only Salt contained in a Water, it may be easily discover'd, and render'd sensible by Evaporation ; and trying whether the dry Matter, upon examination, by the Senses, and particular Experiments, does not manifest all the known Signs of Alum. But when this Salt happens to be mixed with others ; let the dry, mix'd Mass be laid upon a hot Iron-Plate, where the Alum rising in a Blister, and separating from the rest, in the form of burnt Alum, may be afterwards dissolved in distill'd Water, and brought, by CrySTALLIZATION, to the true form, and appearance, of Alum. This Method, indeed, may prove imperfect, especially when other Salts, that swell and rise in Blisters upon a hot Iron, as well as Alum, happen to be mix'd therewith ; as Borax, and the calcareous Nitre do, tho' in a somewhat different manner ; so that, in this Case, a farther Illustration, and Confirmation, must be had from the surer Method of CrySTALLIZATION,

(3) By Crystallization.

47. Altho' a Water shou'd be truly aluminous, yet it may not be practicable, as was also observ'd under Nitre, to make the aluminous Matter crystallize, without the Assistance of a proper Expedient for the purpose. Hence, even at the Alum-Works, the Alum does not appear in its true rocky form at the first Operation, without the addition of Kelpⁿ, and putrefied Urine, whereby we are directed to use the same Expedient occasionally. And thus, if a Water shou'd contain any number of Salts, besides an aluminous one, this may, by Crystallization, properly repeated, be separated from the rest, and render'd sensible, in its own natural Form.

IV. B O R A X.

48. Borax is a Salt not hitherto allow'd to be found native in *England*, for which reason, we shall, in this place, treat more lightly of it; tho' its Natural History is of consequence in Chemistry, and Physicks; as being a Salt of a very extraordinary nature. Its discriminating Properties are chiefly these; viz. (1) Its Form, and Appearance, as brought to us from the *East-Indies*, which is that of dirty Lumps, or a coarse, saline, and particularly fetid Substance, mix'd with much unctuous, earthy, and stony Matter; and in this state it is commonly called Tincal, or Tincar. (2) Its pure, and entire, Crystals,

ⁿ Kelp is a fix'd Salt, or particular Species of Pot-ash, gain'd by burning a Weed, of the same name, which grows frequent on some Shores; and thus reducing it to solid Lumps, or Cakes, of Ashes, that run into a Liquor, somewhat like Oil of Tartar *per deliquium*, by the moisture of the Air.

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when refined; being octagonal Prisms, very finely cut; tho' seldom obtain'd perfect in the ordinary way of refining it. (3) Its particular Taste, not easy to be described; as being sweetish, sharpish, and somewhat urinous, or lixivious. (5) Its Property of soldering Metals, or making them, easily, unite, or take hold of each other; more particularly the parts of Gold. (6) Its making an excellent Flux for Metals, and certain Ores; and by being melted with a proper proportion of Sand, or Flint, turning, in a very short time, to a hard Glass, capable of cutting common Glass, almost like a Diamond. (7) Its extremely vitrescible nature, so as, by itself, with a moderate Heat, and in a few Minutes time, to become true, and permanent Glass.

49. The Ways of discovering whether Borax be contain'd in a Mineral Water are, principally, two; viz. (1) by Evaporation, and (2) CrySTALLIZATION. For (1) since this Salt does not exhale by boiling in Water, (as appears in the refining of it, which requires long boiling) if any of it be dissolved in Water, it will be left behind, among the dry Substance gain'd by a total Evaporation; which dry Substance being laid upon a hot Iron, held over a common, clear, Fire, if any part thus melts aqueous, and rises high, into a white spongy Mass; this may be collected separate, and examin'd, by the Senses, and particular Experiments, according to the Properties above laid down, whether it be Borax, Alum, or the calcarious Nitre; for all these rise, at first, somewhat in the same manner; but if the Fire be continued, or raised to a proper height, the Borax soon melts a second time, and turns to Glass; which, Alum, and the calcarious Nitre, will not do; whereby it may be readily

distinguish'd from them. And this Glass has the same Properties as Borax itself, with regard to soldering, fluxing Metals, &c.

50. (2) But to gain Borax in its natural Form, and Appearance, separate from all other Salts, or foreign Mixtures, we must have recourse to Crystallization. And to obtain it in perfect, or entire, Crystals, certain Additions, Cautions, and Encheireses, are required, wherein consists the Secret of refining this Salt. Thus, in particular, it is necessary (1) to use a strong, alkaline Salt, and Lime-water; (2) to make the Solution perfectly pure; (3) to cover this Solution, whilst it remains hot, and suffer it to cool slowly; (4) to use proper metalline Strings for the Salt to adhere to; and (5) not to open the Vessel, till the Liquor has been, for some time, cold. And thus it may be discover'd whether Borax, perfect, and imperfect, be contain'd in a Mineral Water.

V. SAL-AMMONIAC.

51. Sal-Ammoniac has the following Properties, which may sufficiently distinguish it from any other known Salt; viz. (1) Its taste is much more penetrating, and quick, than that of Sea-Salt, and somewhat urinous. (2) It renders Water intensely cold, whilst continuing to dissolve therein. (3) By Crystallization it shoots into a kind of a light, feathery, or snowy, Substance. (4) When mix'd with any fix'd, alkaline Salt, it yields a pungent, volatile Vapour, that strikes the Nostrils like Salt of Harts-horn, and if the Mixture be sublimed, a dry, volatile, alkaline Salt is thus obtain'd. (5) It has the Property of soldering, or joining Tin, and Copper together. (6) It will, by itself, with a proper

proper degree of Heat, totally sublime, unalter'd in its Nature. (7) It causes certain Mineral Matters, and even Metals, to sublime along with it. (8) It turns *Aqua fortis* into *Aqua regia*, on account of the Spirit of Sea-Salt, which it contains.

52. A knowledge of these Properties, and of the Doctrine already deliver'd, will enable us to discover whether this Salt be contain'd in a Mineral Water; viz. (1) By the Taste; especially after a large proportion of the aqueous moisture is evaporated. (2) By trying whether the Water, after a large Evaporation, will promote the union of Tin, with Brass, or Copper, in the way of soldering. (3) By exhaling the Water to a dry Remainder; and putting this Remainder to common Water, to try if it will increase the coldness thereof: and (5) By dissolving with Water, the Salts contained in the dry Remainder, and crystallizing the Solution; to try if any true Sal-Ammoniac may be thus obtain'd.

VI. *Epsom SALT*, or *Sal Catharticum amarum*.

53. Some of the principal Properties of the *Sal Catharticum amarum*, when perfectly pure, are the following; viz. (1) The form of its Crystals, which appear like small icy Plates, all of them transparent, when singly view'd against the Light; but white when lying in a heap, and view'd by Reflection: Tho' *Glauber's Sal Mirabile* also, will sometimes shoot in the like small, icy Plates, somewhat resembling fine *Sperma Ceti* in the parcel. (2) The considerable bitterness, and penetrating nature, of its Taste, whereby it seems to sink deep into the Tongue; whilst it dissolves quick in the Mouth. (3) Its dissolving totally, and readily, in its own weight

weight of common Water; leaving the Solution coagulable into a white, and almost solid Substance, by the addition of rectified Spirit of Wine. (4) When perfectly pure, and totally separated from Sea-Salt, it neither grows hot, nor makes any Ebullition upon the addition of Oil of Vitriol. (5) Its Solution, in Water, does not turn white, or milky, with the Solution of Silver, in *Aqua fortis*; provided the Salt be perfectly pure; whence we may have a Test of its purity, and entire separation from Sea-Salt. (6) It has a quick, and strong, purgative Virtue; but so likewise has that artificial Salt called *Glauber's Sal Mirabile*. (7) When mix'd with powder'd Charcoal, and set in a strong Heat, it totally exhales, and yields a copious, sulphureous Fume.

54. By these Properties we may be enabled to discover, with certainty, whether the *Sal Catharticum amarum* be contain'd in a Mineral Water; viz. (1) By a remarkable, and particularly nauseous, penetrating Bitterness found upon tasting the Water; especially after some considerable evaporation of its aqueous part: for this Salt will not fly off in the Evaporation; as we know from the manner of preparing it, after long boiling, at the Salt-Works, where it is made from Sea-Water, after all the Sea-Salt is shott, when the remaining Liquor, called Bittern, by a farther Evaporation, and Crystallization, affords the *Sal Catharticum amarum*. (2) As this Salt appears to be the most soluble, in Water, of any Salt, except Sugar, we are not by the Law of Crystallization, to expect it shou'd appear till the other Salts are first separated, from the Mineral Waters that hold it: after which, by a fresh Evaporation, and Crystallization, it may be gain'd in its true figure; and be proved

ect. IV. *The Experiments to be used.*

to be pure, and perfect, by its having the several Properties above enumerated;

VII. *Nitrum murale*, or the calcarious Nitre.

55. This Salt is not only said to be found in Mineral Waters, but also to be procurable by powdering, and boiling, the Mortar of old Walls, and crystallizing the clear Solution, or Lixivium. The Properties of it, so far as hitherto known, are chiefly these; viz. (1) Its Crystals, when perfect, are long, and slender, consisting of four, and sometimes of five, unequal, parallelogram Sides; but one of the Points of two plain Triangles, and the other of two at Squares. (2) It is lightly bitter to the Taste; and does not readily dissolve in the Mouth; nor with the Sensation of Coolness, as true Nitre does. (3) It is a neutral Salt, or neither acid, or alkaline, tho' very different from Salt-Petre; with which it has been confounded; as not being disposed to make Gun-powder, nor *Aqua fortis*, nor to fulminate with Charcoal in the Fire, or to turn to a fix'd, alkaline Salt. (4) When kept upon a hot Iron-Plate, over the Fire, it rises in Blisters, and turns to a light, spongy, white Substance; which when farther urged by Heat, does not vitrify, but remains loose like Lime. The sure Way, therefore, of discovering whether this Salt be contain'd in a Mineral Water, is by Evaporation, and Crystallization, carried to their due length; and examining the Salts separately obtain'd, to see if any one of them answers to the Characters here laid down.

VIII. Mineral A C I D S.

56. Acids are of various kinds, or vegetable, animal, and mineral, with their respective Subdivi-

The Experiments to be used. Part

divisions^o; as Lemon Juice, Renner, Spirit of Sulphur, or Oil of Vitriol, &c. But what are here more particularly concerned with is the mineral Species; or such as being naturally contain'd in the Earth, may come to mix with Mineral Water. And that something of this kind happens in certain Waters, appears to have been generally believed; as all the brisk, spirituous, Mineral Waters are, to this day, call'd by the name of *Acidulae*. This Opinion seems to have arisen first from the Taste of these Waters; which is sharp, quick, brisk and pungent, whilst the Waters are fresh; and secondly from a Supposition, that there is one general, or universal, Acid, contain'd in the Earth; which Acid by corroding or dissolving a suitable Earth, makes Alum, or by saturating itself with Copper, or Iron, makes the respective Vitriols of those Metals, &c.

57. Now, in order to determine whether there is or any other Acid be contain'd loose, or immortified, in a Mineral Water; we shou'd, as in the former Cases, be previously acquainted with the Properties of Acids, as Acids. And these Properties seem reducible to the three following; viz. (1) The Taste, when rightly informed, and prepared; and the Subject properly applied, or in a sufficient degree of strength to be cognizable. Thus, tho' the Juice of Lemmons, and Spirit of Sulphur, are acid, yet they may be so largely diluted with Water, as not to be distinguishable by the exactest Taste. And that the Taste may be ill instructed; or to speak more properly, that the Judgment may form a wrong Conclusion from the Sensation call'd Taste, is certain; because the Taste which

^o See Sect. III. § 17, and the Note thereon; and again § 27.

Some call brisk, quick, or alkaline; has by others been called tart, sour, or acid: which has been the Case in several Mineral Waters. A proper habit of Judging, or a kind of learned, and exercised, Taste, seems, therefore, requisite in this Affair. (2) The Change of Colour, which Acids, (or Liquors wherein any Acid presides) produce with certain vegetable Subjects, or artificial Preparations, is a more exquisite Way of Trial than the Taste, and discovers a much more minute proportion of an Acid than is cognizable by the direct Senses, unassisted by this Expedient. These Experiments are various; thus, if a Water be but lightly acid, a few dried red Roses, or fresh Violets, will give it a fine red Colour; as may easily be tried by adding a few drops of Spirit of Sulphur, Oil of Vitriol, &c. to distill'd Water; and then putting in the Roses, Violets, or their respective Syrups. So, again, if a Water be acid, the addition of a little Oil of Tartar, *per deliquium*, will remarkably alter the Taste of the Water, and give it, for some small time, a degree of briskness, quickness, or pungency, upon the Tongue, which it had not before; and take off the Acidity either totally, or in part, according to the proportion of the Oil of Tartar added. (3) The third, and most essential, or distinguishing, Property of Acids, is that of becoming neutral with Alkalies; and thus forming a new Thing, entirely different, in its Properties, and Effects, from both. This may easily be tried in Juice of Lemmons, and Salt of Tartar, a due proportion of which makes the famous antiemetic, neutral, Mixture of *Riverius*; in distill'd Vinegar, and Salt of Tartar, which make that extraordinary, neutral, Menstruum, and Medicine, call'd regenerated Tartar; in Oil of Vitriol and Salt of Tartar, which make

make the true *Tartarum Vitriolatum*, &c. And hence we are furnished with three principal, and if taken together, three sure, Ways, of determining whether a Mineral Water contains an Acid, in the form of an Acid.

58. The Particulars that may tend to invalidate, or elude, these Trials, are the Volatility of the Acid, the Paucity, and the Mixture of the Acid with other Things. If the Acid of a Mineral Water should be volatile, and, at the same time, in little quantity, we may endeavour, by a careful Distillation, to separate, concentrate, or reduce it to a small bulk, wherein it may bear a large proportion to the aqueous Vehicle, that contains it, and, in this state, make our Experiments upon it; if they should not be capable of discovering it in the natural Water itself. Again, if the Acid be small in quantity, but of a more fix'd nature, so as to sustain a boiling Heat without flying off, Evaporation will easily concentrate, or bring it into a less compass, and make it the better for our Trials. But if it should be mix'd, or intimately united, with an alkaline Salt, Earth, or metallick Substance, it is not to be expected that, in this state, it should directly, manifest itself upon these Trials; as not being the Thing we here intend, or are concerned with; as now making an Ingredient in a mixed Body, where its own particular is destroy'd, or abolished; tho' more powerful Agents, as for instance, a violent Fire, or a proper Distillation with suitable Additions, might here break the Connexion, and recover the Acid, as we see in the Distillation of Nitre, Sea-Salt, Alum, Vitriol, &c. where the Acid is separated from the earthy, or metallick, Matters, wherewith it was before, intimately and strongly united.

IX. Mineral ALKALIES.

59. Alkalies are of two general kinds; earthy, and saline: we are concerned with both of them in the present Enquiry. By earthy Alkalies are meant all those earthy Matters, which of themselves scarce dissolve in pure Water; but being added in a sufficient proportion, to Acids, destroy or abolish, the Acidity thereof; and form a new Thing, of a neutral nature, that in this new, or compound, state, manifests no Signs of a prevailing Acid, or Alkali. And of this kind are Chalk, Limestone, Crab's Eyes, Oyster-Shells, Egg-Shells, &c. Thus, if common Water be acidulated with Oil of Vitriol, and a little Chalk be scraped into it; an Ebullition or Conflict, will presently arise; during which the Water has a brisk, or quick, lively taste; and at length, when the Point of Saturation is hot, all the acidity will be abolish'd, not only to the Taste, but so far, that the exactest Experiments, commonly used to determine Alkalies, and Acids, will here manifest no Signs of either. And this is a certain Characteristick, or the proper Meaning, of an Alkali.

60. Saline Alkalies are of two sorts; fix'd and volatile. How fixed Alkalies are obtainable, by Art, has been shewn above: and some of their principal Properties are the following; viz. (1) They have a fiery, or extremely acrimonious, taste; but no Odour. (2) They are caustick, and if strong, eat, or consume the Flesh, when applied thereto. (3) Being long boiled with Oil, and Water, they make Soap. (4) Of themselves, they are fix'd in the Fire; so as not to lose considerably of their weight

See Sect. III. a6.

therein.

therein. (5) They readily grow moist, and run into a Liquor, by attracting Water out of the Air. (6) Melted with Sand, or any vitrescible, earthy Matter, they make Glass. (6) Added to Spirit of Nitre, or Spirit of Sea-Salt, they bring these Spirits back to their own Salts, respectively. (7) They turn a Solution of Sublimate in Water, yellow, or red; Syrup of Violets, or red Roses, green, &c.

61. Volatile, alkaline, Salts appear to differ but little from the fix'd; except in those Properties which depend upon their Volatility; for these also are caustick, and fiery to the Taste; but, on account of their volatility, briskly strike, and shake, the Nerves of the Nose; being spontaneously volatile, and flying away in the open Air, and in Distillation, rising sooner than Spirit of Wine. These also regenerate Nitre, and Sea-Salt, from their Spirits; tho' the Salts thus regenerated are semi-volatile, or much more volatile than the natural; being in this respect like Sal-ammoniac. And lastly, they produce the same Changes of Colour, upon Mixture, with other Things, as the fix'd.

62. Under this Head of Alkalies therefore, our Experiments must be directed to discover, whether an earthy, a fix'd, saline, or volatile, Alkali, be contain'd in a Mineral Water. And first, if a volatile Alkali shou'd be contain'd therein, we see it may be reasonably expected that this shou'd manifest itself by its Odour, by Additions, or by Distillation. The Odour of a volatile alkaline Salt, if any such be contain'd in a Water, may be perceived by immediately applying the Nostrils thereto; especially as fresh taken up from the Well; for if a very few Grains of the volatile Salt of Hartshorn, or a few Drops of the Spirit of Hartshorn, or Spirit

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of Sal-ammoniac, be mix'd with a Glafs of fair Water ; the Odour of them is very distinguishable. Again, if any volatile alkaline Salt, preside, or be a loose Ingredient in the Water, it will give Signs of itself, by changing Syrup of Violets green ; or the like Experiments by Addition : tho' these Experiments will not, of themselves, determine whether it be a fix'd or volatile alkaline Salt ; because they both act alike with regard to such Experiments : so that here the Assistance of Evaporation, or Distillation, may be used to shew whether the Salt will rise by Heat ; or remain among the dry Matter, after a total Exhalation of the aqueous Parts. And if any considerable proportion of a volatile alkaline Salt shou'd be lodged in a Water ; a gentle Distillation wou'd easily separate it from the bulk of the Water, and bring it over first, in the form of a volatile, or urinous, Spirit ; or Salt ; as we constantly find in the rectification of volatile, urinous Spirit, or Salts, with Water.

63. If a fix'd, alkaline Salt be contain'd in a Mineral Water, it is easily discoverable by the addition of such Things as are known to produce a change of Colour therewith ; tho' these will not distinguish it from a volatile alkaline Salt ; but then Evaporation is a ready Expedient, whereby a dry Matter being procured from the Water, the fix'd Salt may be dissolved, or taken up, by distill'd Water, from the rest, and thus be render'd sensible, in its own form ; at least this may be done after the other Salts, if there are any shall have been separated from it by repeated Crystallization ; for fix'd alkaline Salt, will not easily crystallize, or perhaps not at all, unless it, some way or other, unites with an Acid.

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64. If

64. If earthy Alkalies, or alkaline Earths, be contain'd in a Mineral Water, these also are easily separable from it, and render'd sensible, by Evaporation, and afterwards taking up the saline part of the dry Matter by distill'd Water; for thus all the grosser earthy Substance will be left behind. But how, different earthy Substance may be separated from each other we shall presently shew. For, we are not here concern'd with gross or metallick Earths; but those of the finer, alkaline kind; which in some degree approach to the nature of fix'd alkaline Salts; and may, therefore, in part remain permanently mix'd or dissolved in a Mineral Water, without hindring its transparency; or even pass the Filtre, along with the saline Matter. For such a kind of Earth is found to adhere, or unite, to fix'd, alkaline Salts, and may be separated from them by repeated Solutions, and Filtrations; some of this Earth, each time, remaining in the Filtre. And so much for the general Head of Salts.

II. E A R T H S.

65. By Earths we here mean all those more fix'd Parts of a Mineral Water, which remain behind after a perfect Elixation, or Separation, of the saline Matters, by means of boiling Water; whether these fix'd earthy Parts be calcarious, metallick, sandy, stony, marly, ochry, &c. And tho' possibly all the Species of Earths, when reduced to a sufficient degree of tenuity, or fineness of parts, may lodge in the Pores of Water, without hindring its transparency; yet those that have, by a proper Analysis, been found in Mineral Waters, seem chiefly reducible to three; viz. the calcarious, stony, and ochry; but if any others shou'd be contain'd in a Water,

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ter, they, likewise, may be discover'd, separated, and render'd sensible. For as Earths do not evaporate by Heat, especially not by the Heat of boiling Water; whatever, of this kind, is naturally contain'd in a Water, will, after a total exhalation of the aqueous Parts, remain among the dry Matter left at the bottom: which dry Matter being once or twice boiled in distilled Water, and the Liquor each time filtred, all the more gross terrestrial Matter will thus remain behind in the Filtre. So that if only one Species of Earth be contain'd in a Mineral Water, it is thus easily obtain'd, and made to appear, in its natural form.

66. But, if two, or more, Earths are suspected in a Water; let Care be taken, from the beginning of the Evaporation, to observe, whether any terrestrial Particles concrete, or unite, into small Grains, almost like Dust, or fine Sand, upon the Surface of the Water; for these being carefully taken off, and dried, may prove a different sort of Earth, from that which falls to the bottom in the boiling; as there thus seems to be a difference in their Specifick Gravity, or fineness of Parts. So, likewise, two different Earths may be obtain'd separate, by permitting the Water to stand, for some considerable time, in a wide-mouth'd Glass, loosely cover'd to keep out the Dust; for thus an earthy Skin will often gather on the Surface, and an ochry Substance, or metallick Earth, fall to the Bottom, or line the inside, of the Glass.

67. Precipitation is another Method of separating the earthy Contents of a Water; as, particularly, by adding a fix'd alkaline Salt thereto; which causes the earthy Matter to fall to the Bottom; so as that it may be easily separated by the Filtre; and by being well washed,

and dried, appear in its proper form⁹; and thus be submitted to a farther Examination, by means of Lotion in pure Water; and a proper degree of Fire; whereby its simple or compound nature, may be discover'd.

68. The distinguishing Properties of a calcareous Earth are chiefly these; viz. (1) partly to dissolve, without much difficulty in the Mouth; as if it approached the Nature of fix'd, alkaline Salts; (2) to make an Effervescence with Acids, and take off their acidity; (3) to become highly sharp, corrosive, or caustick, like Lime, by being burn'd, or long detain'd in the Fire; and (4) not to melt, or vitrify, with a strong Heat.

67. Stony Earths, as found in Mineral Waters, are known, (1) by their quick falling to the bottom of the Water, in boiling; and being usually the last that remain after a perfect washing, and separation of the Salts, and other Earths, by repeated affusions of fair Water. (2) By appearing like true Sand; and melting into Glass, in a strong Fire, with fix'd Alkali.

68. Ochry Earths are distinguishable (1) by their natural yellow, reddish, or red, Colour; (2) by growing redder after Calcination; (3) by their rough, styptick, or astringent, Taste; and (4) by their yielding some proportion of Iron, upon fusion.

69. In like manner, all other Earths, whether metallick, sulphureous, or saline, as Ores, Semimetals, Marcasites, Vitriols, &c. have their peculiar Properties; and may be discover'd or brought under the direct cognizance of the Senses, if lodged in a Mineral Water; especially by means of Lotion, Elixation, and Fusion, either alone, or with the addition of proper

⁹ See Sect. III. 26.

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Fluxes, according to the Rules of Metallurgy[†].

III. S U L P H U R S.

70. Several mineral Bodies go under the general denomination of Sulphurs; as Brimstone, Orpiment, Petroleum, Bitumen, &c. but we are only concern'd with those, at present, that may lie concealed, undistinguishably to the Eye, in mineral Waters; and such are chiefly supposed to be Brimstone, and Orpiment: But, as Orpiment is not allow'd to be found native in *England*, we need not here be solicitous about it, any farther than to rectify some Mistakes which have crept abroad to its disadvantage, as if it were, what it is not, a poisonous Mineral. The true, native Opiment, or Auripigmentum, is a yellow, sulphureous, shining, or spangly, Mineral, (consisting of little flakes, or scales, like Talc) and comes to us from *Greece*, where it is dug out of certain Mountains. It is a very different Thing from all the Species of Arsenic; which are Artificial Preparations of Cobalt, a poisonous Mineral, found in *Misnia*, where the several kinds of Arsenic are prepared. Orpiment being reduced to powder, and set in the Fire, will flame, and emit a white, or yellowish Fume, yielding the odour of common Brimstone; and thus changing the surface of a polished Iron-Plate held in it, of a white, yellow, and reddish Colour; leaving a proportion of sandy Earth behind. It is used, by Painters as a Gold-Colour, and for making that called Sympathetick Ink, &c. It is sold common, at the Colour-Shops, without the suspicion of its being poisonous, any more than Antimony, or Brim-

[†] See Chemical Lectures: Lect. XVII, and XVIII.

stone; and some have used it medicinally, by the way of Fumigation, and for venereal Ulcers; and others internally, for the Asthma, without finding it prejudicial. Upon the whole, Orpiment appears related to Antimony; which is also a sulphureous Mineral, that remains innocent so long as it is join'd with its Sulphur; but proves emetick, or deleterious, when separated from it: and in, like manner, not to mention other correspondencies, does Orpiment. We have been the more particular in this account, because some eminent Persons, not distinguishing betwixt Orpiment, and Arsenic, have erroneously, imagined that possibly Mineral Waters might be poisonous on account of their containing Orpiment; and again to give the Characteristicks of it, whereby it may be known, and distinguish'd; tho', as was before observed, it is not found native in *England*. But, if it were, and tho' any Mineral Water shou'd be impregnated with it, (of which no Instance has hitherto appear'd) yet the same Experiments that serve to discover Brimstone in a Mineral Water, may also serve to discover Orpiment.

71. Some of the principal Characteristicks of Sulphur, or Brimstone, are these; viz. (1) It melts readily over a soft Fire, and soon grows hard again in the Cold. (2) It is very inflammable; and burns with a livid, or blue, Flame; at the same time, diffusing, from a very small quantity, a copious, and peculiarly offensive, suffocating Vapour, or Fume. (3) Being thus burn'd under a Glass Bell, this Fume condenses into a highly acid Liquor, called *Oleum Sulphuris per Campanam*. (4) It is absolutely necessary in the making of Gunpowder; as fulminating, and having its nature entirely destroy'd by Nitre, in the Deflagration. (5) It readily unites in the
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Fire, with fix'd Alkali ; and thus makes a dusky red, or liver-colour'd, Mass ; which being dissolved in Water, and precipitated, affords an extremely fetid Odour, like that of a rotten Egg. (6) Being distill'd with Quicklime, and Sal-Ammoniac, it affords a yellow, smoking, and highly fetid Spirit : so, likewise, do those two sulphureous Minerals, Orpiment, and Antimony. (7) Its Solution in a Lixivium of fix'd Alkali, changes Silver black. (8) Being melted, and mix'd with Quick-silver, the whole presently turns to a black Mass. (9) It dissolves into a Balsom by being boiled with Oil. (10) It demetallizes Iron, applied red-hot thereto ; and has other surprizing Effects upon Metals.

72. These Properties of Sulphur may sufficiently enable us to discover, whether it be contain'd in a Mineral Water : the Ways of doing which seem reducible to two ; viz. (1) By Additions to the Water ; and (2) By treating the dry Matter left after Evaporation. But we are to observe that Sulphur, in an unmix'd state, does not easily, or perhaps, at all, dissolve in pure Water ; nor in acid Liquors ; tho' it does in such as are alkaline : whence it is chiefly to be expected in Mineral Waters of an alkaline nature. And here it may be easily discover'd by laying pieces of pure Silver in the Water to try if they will be discolour'd, or turn'd black therein ; or by adding a Solution of Silver to the Water ; to try if any blackness ensues. The Odour also, being like that of rotten Eggs, or a foul Gun-barrel, will usually discover such a Mixture of Sulphur. But (2) a more general, and satisfactory Way, is to evaporate the Water, and examine the dry Remainder, by laying part of it upon a hot Iron, to see if thus any thing melts

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easily,

easily, takes Fire, or burns blue, with the peculiar Odour of fired Brimstone; or if by burning, under a Glass Bell, it will yield the *Oleum Sulphuris*. And lastly, let Spirit of Vitriol, and Water, be added, in a sufficient quantity, to a part of the dry Remainder; whereby a Precipitation of the Sulphur, if there is any, will be made; which now falling, in the form of a Powder, to the bottom, may be collected separate, sublimed into Flowers, or melted, and thus reduced to a solid lump of Brimstone, like the common.

IV. FUMES, or SPIRITS.

73. By Fumes, or Spirits, we here mean, in a general Sense, those fugitive, or volatile, Parts of a Mineral Water, which spontaneous fly off from it in the open Air; or quit the Body of the Water with a less degree of Heat than serves to raise the mere aqueous parts thereof, in Vapour; or by common distillation.

74. The Fumes, or Spirits, of this kind having never hitherto been collected separate, and examin'd, it cannot be expected that we shou'd here describe their Properties, or Effects; but as there is sufficient Evidence to shew that such Spirits, or subtile, fugitive Matters, do lodge in certain Mineral Waters, more especially in those of the brisk, alkaline and cold sort; and that they very readily desert the Body of the Water, upon standing open, or feeling a small degree of Heat; (thus leaving the Water more spiritless and vapid) our best Endeavours shou'd be used to manifest, or render sensible, to separate, collect, and examine these Spirits, in order to determine their Natures, Properties, and Uses. And the Ways of doing this seem reducible to the following ten; viz. (1) The Smell; (2) The Taste; (3) The Sight; (4) The Specifick Gravity;

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ity; (5) Expansion; (6) The Exhausted Receiver of the Air-Pump; (7) Distillation; (8) Effects upon Drinking; (9) Additions; and (10) Direct Collection, and Weight.

75. (1) If a Mineral Water, when a Glass of it is fresh taken up at the Well-Head, and applied near the Nostrils, shall prove to have a brisk, quick, or pungent, Odour; but loses this Odour, after standing, for some time, in the open Air, or feeling a small degree of Heat; it may be presumed that such a Water naturally contains what may be called a Spirit: at least it will hence be certain, that the Water, by standing open, or feeling a small degree, loses the Property which it had when fresh, of striking the olfactory Nerves, in a particular manner, so as to cause a certain Sensation denominated by that particular Odour.

76. (2) So, likewise, if a Mineral Water shou'd have a brisk pungent Taste, when fresh taken up, but lose it soon after, by standing in the open Air, or by being exposed to a moderate warmth; this also wou'd afford a Presumption that the Water naturally contain'd a Spirit.

77. (3) Again, if a Glass of the Water, when fresh taken up, shou'd manifestly sparkle, and throw numerous Bubbles to its Surface; or when shook in a Glass close stopp'd at the Mouth, and then immediately open'd, shou'd appear to displode, or throw off a large Mist, or Vapour, and appear to bubble, or sustain a strong internal Conflict, or commotion in its minute Parts; but not do the same, or in a much less degree, after standing in the open Air; it wou'd hence, at least be probable, that the Water naturally contain'd a Spirit, or subtile, active Part, which readily quits the less active, and flies off into the open Air.

78. (4) If

78. (4) If the Specifick Gravity of a Water be taken in the Well, or immediately after it is brought up in a proper Glass for the purpose; and if upon repeating the Experiment some time after the Water has stood exposed to the open Air, in the same Glass, it shou'd now prove to have a considerably greater Specifick Gravity than before, that is, if its Parts shou'd thus appear to have come closer together, or the Body of the Water to be grown denser; this also wou'd plainly intimate that the Water naturally contains a light, or volatile, Substance, which keeps its Particles at a greater distance, whilst that volatile Substance remains therein; but suffers them to come closer together after it has deserted the Water.

79. (5) If thin Glass Vials, or common Bladders, fill'd, or half fill'd, with a Mineral Water, and well secured at the Orifices; be brought before the Fire, or set in a dry hot Copper; and if other with the same Water (after having stood in the open Air) the like Glasses, and Bladders be also fill'd, or half fill'd, and secured, in the same manner; and the Bladders containing the first Water shou'd distend, or burst, sooner than those containing the second; or if the Vials containing the former, shou'd break sooner, (with the same degree of Heat) than those containing the latter; this wou'd shew that the first Water held something more elastick, spirituous, or expansive than the other. The Experiment with the Glass Vials might be made by setting them in a Copper of Water; with their Necks coming out at Holes made in the Cover; so as to prevent any danger from their bursting: for thus the Heat wou'd be applied equally, and might be exactly measured by a Thermometer, made with Oil, or Quicksilver: tho' there may be some difficulty

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culty in procuring Vials, or Bladders, of the same degree of strength; but then it may be tried whether the Mineral Water fresh taken up, will not break a Glass which cou'd not be broke by a parcel of the same Water which had stood open for some time.

80. (6) If a Glass of the Water, fresh taken up, be set under the Receiver of an Air-Pump; along with another similar and equal Glass of the same Water after it had stood exposed to the open Air, or a moderate Heat; and if when the Air is drawn out of the Receiver, the former shou'd sparkle more, or throw up a much greater number of Bubbles than the latter; it wou'd hence appear that the former contain'd more Air, or more of an explosive Substance, or Spirit, than the latter.

81. (7) If a Mineral Water be, at the Well-Head, directly put into a clean Glass Retort, and a Receiver be immediately luted on, with a piece of wet Bladder, tied tight with a wax'd Thread; and now the Retort be directly placed in a *Balneum Marie*, or proper distilling Furnace; if any thing like Air, or Wind, shall appear to puff thro' the Luting, or cover'd Joint, at the very beginning of the Operation, or as soon as the Retort grows moderately warm; or if either the Retort, or Receiver, shou'd burst, without any manifest external violence, or imprudent management of the Fire; this wou'd shew that an explosive Vapour, or Spirit, thus came from the Water. And if the same Effect did not follow upon the like Distillation of a parcel of the same Water, that had been heated before, or exposed to the open Air; the former Conclusion wou'd be considerably verified.

82. (8) If

82. (8) If a Mineral Water, when drank fresh, at the Well-Head; shou'd have a kind of intoxicating Effect, or give a considerable degree of Alacrity, or occasion the Head-ache, a Drowsiness, &c. but have no such Effects, when drank in the same quantity, by the same Persons, after having been warm'd, or after having stood, for sometime open; this also may shew that the Water, when fresh, naturally contains a Spirit.

83. (9) If a Glass of any Mineral Water, fresh taken up at the Well-Head, being mix'd with a light Acid, or particularly with *Rhenish* Wine, and Sugar, shou'd make a strong Ebullition, with a large white Froath, or Foam, and discharge a visible Mist, or Vapour, to a considerable height; and during this Conflict taste extremely keen, brisk, or pungent; but do thus in a much less degree, upon the same Experiment, after having stood, for some time, open to the Air; it will hence also appear that the Water naturally contains a light, subtile, active Matter, or Spirit, which it loses by standing in the Air. So, again, if a Mineral Water shou'd when fresh, or perfect, change its Colour remarkably upon the addition of the fresh Powder of Galls, and turn with it either purple, dusky or inky; but not do this at all, after the Water has been taken up, and suffer'd to stand in the Air, for a few hours; it wou'd hence also follow, that the Water naturally contains a Spirit, in our sense of the word; and that this Spirit, is, at least in part, an actual volatile Iron, or volatile Vitriol of Iron; as no other Thing is found to have this Property.

84. (10) We come, in the last place, to an Experiment which may, if it succeed, be of itself esteem'd conclusive; but join'd with all, or some of the foregoing, will amount to a physical

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Sect. IV. *The Experiments to be used.*

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fical Demonstration. The Experiment is this. Take a Vial, a Bolt-head with a proper neck, or a common Quart Bottle; and nearly fill it with a Mineral Water, at the Well-Head; have in readiness a fine, limber Bladder, well rubbed and made thoroughly supple, or pliable, by oiling it on the outside, and rubbing it betwixt the Hands, with Care to squeeze all the Air out, in which state it shou'd be carefully weigh'd, in an exact pair of Scales; immediately tie the neck part of this Bladder over the mouth of the Glass, with a waxed Thread, as tight as possible; then remove the Glass to a proper Furnace, or gentle Heat of Sand, or Water; where, if upon standing a while to grow warm, the Bladder appears distended, as if it were blown up; squeeze the neck part of it, to gain a Vacuity, and there again carefully pass a wax'd Thread, (which also shou'd be weigh'd beforehand, or along with the Bladder;) and now taking off the former Ligature, the Bladder may be removed, and weigh'd again, to see what additional weight it has gain'd by the Matter, or Spirit, wherewith it is distended; allowing (if weigh'd in the Air, and not *in Vacuo*) for the difference of specifick Gravity betwixt the Bladder flaccid and distended, or so full blown, and empty: And if any absolute weight be gain'd, this is the weight of the Spirit contain'd in the quantity of Water made use of; provided the Experiment was perfect. And thus the Spirit of a Mineral Water may, perhaps, not only be made sensible, as Air in a blown Bladder, to the Eye, the Touch, &c. but also, be submitted to a variety of other Experiments; in order to discover its Nature, Properties and Uses. And here it should be particularly examin'd whether the Spirit be a simple, or a compound; if a compound,

pound, how it may be resolved; how imitated; how introduced artificially, into Water; how it is naturally made, or whence it proceeds, &c.

85. We have now, in our manner, gone thro' the four general Classes, under which the principal Contents, or Ingredients, of Mineral Waters, seem to be reducible; viz. *Salts, Earths, Sulphurs* and *Spirits*; for the mere aqueous Part, which is the Vehicle, or Menstruum, of the whole, we have here no particular Regard to; as being not, strictly, an Ingredient in Mineral Waters; but a kind of general Instrument, or Agent; whose Properties, Office, and Use belongs to another Enquiry^f.

86. But it will recur, to the Imagination, that there may still, possibly, be *Salts, Earths, Sulphurs, Fumes, Spirits*, or many other Things, of an unknown Nature; that, either in a smaller, or larger, proportion, entering the natural Composition, or Mixture, of Mineral Waters; and such, as no Experiments, hitherto divided, can any way, discover, or render sensible. This Objection indeed, is readily suggested by the Imagination; but how far the Reason approves of it, remains to be consider'd.

87. No one tolerably acquainted with the present State of Chemistry, and Natural Philosophy, will pretend that either of them is arrived near to Perfection; or that the Ways of making a true and proper Analysis of all natural and artificial Bodies are hitherto known. On the other hand, it must be allow'd that many useful Separations, Compositions, and Recomplications of Bodies have already been made; and that many more might still be made, if Natural Philosophy, and Chemistry, were farther

^f See Chemical Lectures. Lect. V.

improved.

approved. But, with regard to Mineral Waters; when the Affair is fully examin'd; it shou'd seem that the Means of Discovering their Contents, Virtues, and Uses, are already in the Hands of Man; and that nothing more is wanting to compleat the Work, than a prudent, scientific, and guarded Manner of using these Means; or to speak plainly, the principal Thing required is the Art of Induction. For, even the present, common, and very imperfect Chemistry supplies us with numerous Experiments, and sure Ways of discovering the Contents of Liquors; and bringing them under the direct Cognizance of the Senses; and a higher, or more philosophical, Chemistry, as now practis'd by many skilful Philosophers, will here penetrate farther: So that, if Chemistry shou'd continue to improve, scarce any Analysis of this kind, wou'd, at length, prove too hard for it.

88. But, to come closer to the present Objection; What are those Things, suggested by the Imagination, to be contain'd in Mineral Waters, which no Experiments, hitherto known, can discover? Let us consider whether these Things are not Creatures of the Imagination; for so they must be allow'd, by Men, to be, if they are not discoverable by Sense, Experiment, or Reason. But if at present discoverable by Sense, or Experiment, the Objection vanishes; as depending upon a Supposition that they are not thus discoverable, at present. The Strength of the Objection, therefore, seems to be this; that the Imagination, by casting about, suggests to the Reason, that there are many Compound, or Mix'd, Bodies, which cannot, by any Experiments hitherto known, be resolv'd into their Constituent Parts; so as fairly to exhibit these Parts, in their simplest state, separated from each

each other, and unalter'd in their Properties but that either, some will be so changed, or broken off, in the Operation; as not, by a re-union, to exhibit the same Subject again: Or, with regard to Mineral Waters, that these may naturally contain various Parts so subtile, so intimately united, or of a nature so utterly unknown as not to be reached by any Artillery of Chemical Experiments; and yet that these Waters may manifest particular Virtues, or perhaps have pernicious Effects, in the Body; on account of some latent Properties in them, which no dead languid, or incompetent Trials, made out of the Body, are subtile, or exquisite enough to discover.

89. We have endeavour'd to obviate this Objection in the Course of our Procedure; but to clear it up, more expressly, and answer it fully with particular Instances, and Examples, would lead us too far from our purpose; and engage us deeper in Chemistry, than is, at present, necessary. Those, therefore, who require more Satisfaction, in this Point, than they can derive from the present Enquiry, (tho' we hope that will be sufficient) may please to consult the Chemical Lectures, already, more than once, refer'd to; particularly those which treat of Water, and of Synthetical, and Analytical Chemistry. We shall, however, here add, as a Supplement to the Way, already laid down, for discovering the Contents of Mineral Waters, the general Method of making an Analysis thereof; whereby whatever known, or unknown, Substances, especially those of a fix'd Nature, contain'd in a Water, may be render'd sensible, or brought to their true form and appearance; so as to be farther examin'd, or have their respective Natures and particular Properties disclosed.

S E C T.

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S E C T. V.

A general Method of Analysing Mineral Waters.

1. L E T the first Intention be to make a natural Analysis of the Water, or to see what Changes it will spontaneously undergo, or what Parts, or Matters, it will separate into, by standing in open, and close, Glasses. Thus, low, cylindrical, open Glasses, being fill'd with the Water at the Well, let them be directly examin'd by the Eye, the Smell, and the Taste; and again after standing for an hour, two hours, four hours, a day, or several days; to discover the sensible Alterations occasion'd by this standing, as compared with more of the Water, fresh taken up; and particularly, to find whether any visible separation of parts ensues: and if a Scum appears on the top, or a Sediment at the bottom, let them be carefully collected, and preserved, for farther Examination; observing to keep a Diary, or Register, of all the Phænomena, and the whole Procedure. And let the like Experiment, or Observation, be made in Glasses exactly closed, to discover the Changes which the Water will thus undergo, in its sensible Properties, and the Matters it thus separates, or throws off to the top, sides, or bottom of the Glasses.

2. Let the Experiment, in some of the open, cylindrical, Glasses, be prosecuted, by keeping them in a warm place, till the aqueous part is totally exhale'd, and only a dry Substance left behind; which being reserved, may be compared with the dry Substance, gain'd from the same Water, by Evaporation over the Fire;

in order to shew whether there be any remarkable difference betwixt the two dry Substances, thus procured.

3. Let the next Intention be to make an exact Chemical Analysis of the Water; and to compare it with the former. In order to this, let a certain quantity of the Water; suppose five or six pounds, Troy; be, at the Well-Head, put into a Glass Retort, with a wide Neck, and a clean Glass Receiver be immediately luted on, in an exact manner; let the Retort now be directly placed in a proper Furnace; and work'd with a very moderate Heat, so as barely to make the Water simmer; and proceed, with this degree of Heat, till all the aqueous part is come over; and only a dry Substance left at the bottom of the Retort; then, letting the Vessels cool, take away the Receiver, carefully weigh the aqueous Liquor, and keep it apart in a clean well-stopp'd Glass. And, lastly, separate the dry Matter, from the Bottom of the Retort; weigh it, whilst thoroughly dry; and put this also into a clean, dry Glass, to be kept well stopp'd.

4. At the beginning of this Operation, as soon as the Retort grows warm, let Care be taken to observe whether any volatile, or explosive, Vapour comes out at the Joint, where the Luting was applied; for if there does, this shews that there is a Spirit, or light subtle, Matter, separable from the Water; tho' not capable of being thus collected: whence we are admonished to use another Method, in order to render it still more sensible, and subject it to particular Experiments; according to the Directions of the preceding Section.

5. The aqueous Part, obtain'd by the Distillation, may be examin'd with various Additions,

tions, or by applying it various Ways, in order to discover, if, in any respect, it differs from pure, distill'd, common Water; or whether it be impregnated with any saline, or mineral Particles, like those found, by the same Trials, in the natural Mineral Water. Thus, as was formerly observ'd, if it contains any Sea-Salt, it will be apt to turn white with a Solution of Silver; if any Viteriol of Iron, it will turn black with powder'd Galls; or if any Sulphur, united to an alkaline Salt, it will turn black, in time, with almost any metallick Solution. And thus its difference from common Water, or the mineral Water, that afforded it, may be assign'd by a proper variety of Experiments.

6. Let part of the dry Matter, left behind upon the Distillation, be put to, or gently boil'd with, five or six times its own Weight of the purest distill'd common Water, thus freed, and before-hand proved, by particular Experiments, to be freed from any sensible known mineral Particles; for by this means all the saline part of the Matter will be taken up, by the pure Water, in the form of a Solution; which being filtred, evaporated to a proper Height, and set to crySTALLIZE, will thus give out its Salt, in the figure, or form, peculiar to itself. And tho' several Salts should be lodged in the same Solution, they may all, by repeated Evaporations, and CrySTALLIZATIONS, be obtained separate, (according to what has, more than once, been observed before) and examin'd, to try whether they are of a known, or unknown, kind: And tho' the kind of any Matter thus procured, should happen to be utterly unknown; yet certain chemical, and philosophical, Experiments, might be contrived to discover its Properties, and Uses: according to the common

Rules of Chemistry, and Experimental Philosophy. Thus, for Example, it is easy to determine whether any Salt, thus obtain'd, be of an acid, or alkaline Nature; by knowing the Properties of each kind, as they are above laid down*: for acid Salts turn red with Syrup of Violets, and become neutral with Alkalies, &c. And Alkaline Salts turn green with the same Syrup; become neutral with Acids; cause Sal-Ammoniac to emit a volatile, urinous, Vapour; turn a Solution of sublimate Yellow, &c.

7. But the Difficulty may seem greater to determine the neutral Species of Salts. And here we learn, from natural History, and Chemistry, that the neutral Salts dissolved, or washed out of the Bowels of the Earth, by Water, are chiefly Sea-Salt, and such as consist of a sulphureous, or vitriolick Acid, (that is, an Acid like the Acid of Brimstone, or Vitriol) and a Salt, or Earth, of an alkaline Nature. But Sea-Salt is easily discover'd by its Taste, cubical Figure in Crystallization; and the particular, white Vapour, which it largely affords upon mixing with Oil of Vitriol: The other kind of neutral Salts may be distinguish'd from all others by the Property they have of producing, or regenerating Sulphur, upon being mix'd, and melted with Salt of Tartar, and powder'd Charcoal. Thus, for instance, if two ounces of such a Salt be mix'd with an ounce of Salt of Tartar, and an ounce of powder'd Charcoal; and the Mixture be melted in a Crucible, there will thus be produced a reddish colour'd Mass, of a sulphureous, alkaline Taste, that gives a high yellow, or golden, Tincture to rectified Spirit of Wine; which Tincture will discolour Silver, or turn it

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black; and being precipitated by an Acid, affords a true *Lac Sulphuris*, that may be sublimed, and melted into Brimstone, like the common.

8. What remains behind after a perfect Elixation, or total Dissolution, of the saline Matter, by means of boiling Water, comes under the general Name of Earth; which by repeated Washings, in pure distill'd Water, and each time pouring off the Water, may happen to be separable into terrestrial Matters of different kinds; according to their different Natures, or specifick Gravities; as for Example, into Bolus Earth, or Oker, calcarious Earth, and Sand, or other Species of Earths: which if thus separable, may be examin'd by particular Additions; or by the Fire, in order to determine their kinds, and natures; as whether they are vitrescible, or convertible into Glass, by a strong Fire of Fusion; or whether they will calcine, and turn into a kind of Lime; or whether they will yield any known, or unknown, metallick Substance, or Regulus. But if the terrestrial Matter be not thus separable by washing; let the whole be examin'd, in the Fire, to try if it will here separate into parts of different kinds; as it may, if a compound, into a calcarious, a metallick, and a glassy part; being either assay'd alone, or with the Assistance of Borax, Glass of Lead, or other suitable Fluxes. And if the metallick portion should be small, so as not to be collected separate, let it be fused with the powder of pure crystalline Glass; to see if it will thus tinge the Glass of any particular colour; whereby a Conjecture may be formed of the Species of the Metal it contain'd; as whether Iron, Copper, Silver, &c. which, reduced to a Calx, are found to give

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specifick, or respectively different; Colours to crystalline Glafs in Fusion.

9. And after this manner we apprehend that a tolerably exact, and instructive Analysis may be made, and an useful, if not satisfactory, Account given of the Contents, and Virtues, of any Mineral Water; without entering into a more minute and circumstantial Enquiry; as directed by the Heads laid down in our second Section. And as we are not yet sufficiently prepared to give satisfactory and full Answers to all the Questions there proposed, with respect to the *Scarborough Waters*; we shall, for the present, content ourselves with giving the Analysis of these Waters, according to the Method of the present Section; referring to a future Enquiry what we shall have farther to offer upon the Subject.

10. It is but just, at the Conclusion of this first Part of our Undertaking, that we ask Pardon of the Reader, (who may be much better acquainted than ourselves, with the Ways of examining Mineral Waters,) for having dwelt so long upon the Method of doing it; and inculcated some Particulars several times over: But, to say the Truth, as the Treatises which we have read upon this Subject, appear to us far from laying the just Foundations of the Thing, or from observing a proper Form of Induction; and as many have objected to the Thing itself; on a Supposition of its being precarious, and uncertain; we found ourselves in some measure obliged, for the sake of the Many, to trespass upon the Patience of a Few; and endeavour, even by some degree of Repetition, to set this Matter in a fair Light, that every one might be able to exercise a free Judgment upon it. And in this respect, it is to be feared we have rather fallen short, than exceeded.

P A R T

PART II.

An Attempt to analyse the Scarborough Spaw-Waters.

SECT. I.

Of the Scarborough Spaw-Waters in General.

1. **T**HERE are two principal Wells of Mineral Water at *Scarborough*; which, tho' within a few Yards of each other, have yet some remarkable Differences: and that farthest from the Town being the more purgative, and that nearest the Town the more chalybeate; the former may, for distinction sake, be called the Purging, or Cathartick, and the latter the Steel, or Chalybeate, Well.

2. These Wells lie under a large Cliff, on the Sands, to the South-West of the Church, and about a Mile distant from it. They are so near the Sea, as usually to be cover'd by it at Spring-Tides: but at other Times, there is a commodious Passage to them, along the Sands, which as the Tide goes down, presently become dry, and firm.

3. The Waters, apparently, trickle into these Wells, which are Stone-Basins, by several Veins running from the Bottom of the adjacent Cliff; which chiefly consists of common Clay, Stone, Earth, and Gravel, a-top; but of Iron-stone, Alum-stone, Lime-stone, and many compound Petrefactions, below.

4. The Water of each Well appears to be clear, or pellucid; like common Water; both in the Well, and when taken up in a clean Glass; tho' not so perfectly bright, and crystalline, as the purer kinds of Rock-Water. And there are visible Marks of a yellow, or ochry, Substance deposited by each Water, on the sides of the Waste-Pipes, and the adjacent Parts of the Well, exposed to the open Air.

5. The Eye perceives no difference betwixt the Water of the Purgative, and that of the Chalybeate, Well; but to the Taste there is a manifest difference, chiefly in two respects; for the Purgative Water, especially when strong, tastes distinguishably bitterish; which the Chalybeate Water does not usually do: And again, the Chalybeate Water tastes more brisk, quick, or pungent, than the Purgative, at the Well-Head.

6. They both have that Taste denominated brackish, ferruginous, or irony; called by some also the Taste of the Mineral; and this, as distinguished from their brisk, quick, or spirituous Taste.

7. When tasted deliberately, and (if the Expression be allowable) with some degree of Skill, this quick, or spirituous Taste, is not found to be any kind of tartness, acidity, or sourness; but a certain pungent briskness; somewhat like that of sound, and ripe Malt-Liquors; or what exactly resembles the Thing, the Taste of Water first made sharp, or tart, with Spirit of Vitriol; and this Sharpness afterwards taken off by the addition of Salt of Tartar; the Mixture being tasted whilst the Confect, or Ebullition, (here made by the Acid and Alkali) continues.

8. The

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8. The Smell of both Waters, fresh taken up, is, to a quick Nose, manifestly brisk, or spirituous; and also ferruginous, or irony; that is, in common language, they smell of the Mineral; but more strongly so, after having been briskly shook in a Vial, with the Orifice close stopped, then suddenly opened, under the Nostrils.

9. When poured out of one Glass into another, or shook in the Glass wherewith they were taken up, they generate numerous Bubbles; and if shook, for a while, in a close stopp'd Vial, and the Vial be suddenly open'd before the Commotion ceases, they displode a kind of Vapour, with an audible Noise, and a perceptible Force, somewhat like what is found upon opening a Bottle of ripe Malt-Liquor.

10. In point of Coldness, they appear not to differ from each other; or from common Water, defended in the same manner, against the Sun, and the open Air.

11. The specifick Gravity of both Waters, taken at the Well-Head, is variable; not only with respect to each other, but also with respect to common Water. At sometimes, when carefully examin'd, with the same Hydrostatical Balance, their specifick Gravities are nearly equal; but at others, different: tho' both are usually somewhat heavier than common Water; but more particularly that of the Purging Well.

12. Both Waters, if set fresh under the Glass Receiver of the Air-Pump, discharge numerous Bubbles, when the Air is extracted; but the Purging Water thus appears to afford more, and larger Bubbles, than the Chalybeate, and to dart them up with a greater Velocity; tho' neither of them, by standing, for several Minutes, in *Vacuo*, and discharging their Air, seem

seem to lose of their brisk Taste, mineral Virtue, or Spirit.

13. Being drank fresh, at the Well-Head by a healthy Person, of an ordinary Constitution, in the quantity of four or five half-Pints in the space of an Hour, the Purging Water is found to operate quick, and give about two, or three easy Motions; at the same time, not sinking but, remarkably, raising the Spirits, or causing a degree of Cheerfulness: And this the Chalybeate Water seems to do still more; tho' it purges less, and goes off chiefly by Urine.

14. Both Waters, when fresh, presently strike a dark red, or purple, with Green Tea, or Powder'd Galls; tho' the Chalybeate does this with greater celerity, and in a higher degree than the other.

15. They both make a small Ebullition with Acids, and soon destroy the Acidity thereof. Thus, for Example, an ounce of the Purging Water will entirely take off the Acidity of a full drop of well rectified Oil of Vitriol. And if Sugar be added to these Waters, at the same time that an Acid is, and the Mixture be stirred together; it immediately creams, or flowsers, and sparkles, or rises in a foam; and thus the Chalybeate Water drinks very agreeably with *Rhenish* and Sugar; but the Purging Water less.

16. They both turn Syrup of Violets green, and let fall a copious white Earth, upon the addition of *Oleum Tartari per deliquium*.

17. They both curdle Milk, by being boiled therewith; and thus make an agreeable kind of Whey; having nearly the same diuretic and purgative Virtues as the Waters.

18. They do not lather; but curdle; with Soap; they serve very well in Brewing, with Malt

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Male; making the Liquor somewhat purgative; and they will, in some considerable degree, supply the want of Yeast, in Baking, or the making of Bread.

19. They are found to differ considerably with the Seasons of the Year, both in respect of Taste, and medicinal Virtues; according as they are weaken'd by Rains; chill'd by Frost; beat upon by the Sun, &c.

20. When suffer'd to stand, in an open Glass, for some hours, or days, in the open Air, they lose of their transparency, and brisk, or spiritous, Taste; as also their faculty of striking purple with Galls; a gross earthy Substance gradually falling to the bottom; and a lighter gradually appearing, in the form of a pellicle, or icy Skin, on the top; like what we find on the top of new made Lime-water.

21. If suffer'd to stand thus, well defended from dust, or other foreign admixtures, till the aqueous Part is totally exhaled, many Grains, or small Shoots, of a true saline Substance, will appear intermix'd among a more gross, earthy Matter.

22. On the inside of the Glass Bottles, which have long served to carry these Waters from the Wells, is found an ochry Scurf, or ferruginous Substance, thus deposited by the Water, or naturally separated from it.

23. Sometimes also, by long standing in the Bottles, tho' well secured by common Corks, these Waters have been found to putrefy, and grow extremely fetid: and this the sooner if the Bottles were not new, or thoroughly cleansed from all remains of any fermented Liquors they might have before contain'd. But in Time, this Putrefaction finishes its Course, and the Water becomes sweet again.

24. The

24. The Intimations, afforded by the preceding Observations, seem, with regard to the present Enquiry, to be chiefly these; viz. (1.) That the Waters of the two Wells have considerable affinity with each other; both in respect of their Origin, sensible Qualities, Contents and Virtues; so far as these have been hitherto consider'd: the principal medicinal Differences appearing to consist in this, that the Chalybeate Water is more spirituous, less purgative, and more diuretick than the other^a.

25. (2) That, possibly, both Waters are originally no more than common Water impregnated with different proportions of certain mineral Matters capable of dissolving, or lodging, in the Pores thereof; as being taken up, or imbibed, by the Water, in its Passage over particular Beds of Minerals, till it arrives at the Wells^b.

26. (3) That these Waters are a natural Compound of (1) Air^c, (2) a mineral Spirit, or volatile Iron^d, (3) common Water^e, (4) Salts^f, (5) Oker^g, and (6) Earth^h.

27. (4) That this Compound is subject to great alterations, and liable to have its nature and texture alter'd, by various accidents; or even by long standing, or admission of the common, external Airⁱ.

28. (5) That these Waters are of a considerable alkaline, evacuating, fermentative, and putrefactive, nature^k.

29. This Information, tho', in itself, but slender, and not sufficiently verified, is yet of

^a See above, § 1—23.

^b See § 12.

^c See § 9, 12.

^d See § 5, 6, 7, 8, 9, 12, 13, 14.

^e See § 3, 4, 20, 21.

^f See § 21.

^g See § 4, 22.

^h See § 16, 20, 21.

ⁱ See § 11, 19, 20, 21, 23.

^k See § 15, 16, 18, 19.

23.

considerable use; as it affords some knowledge of the subject, and directs a farther Enquiry into it; by means of a more exquisite Analysis, capable of separating the Principles of the Waters, and exhibiting them in their proper forms, so as to shew in what Parts, or Ingredients, the several Properties, and Virtues of these Waters reside.

30. And as an exact chemical Analysis of the Waters is the Thing here principally intended; it was necessary that we shou'd be previously acquainted with the natural Properties, and Effects, of the Subject: otherwise we should want a Foundation whereon to proceed; and not be enabled to know what Changes are wrought by our future Treatment; what Parts, or Principles, we are to expect, and endeavour to separate; and how to know, and prove, when we have obtain'd them. Accordingly, it is a fundamental Rule, in Chemistry, first, with Care, and Exactness, to view and scan the Subject, and learn its natural Properties, Powers, and Effects; before it is chemically examin'd, and, after the Operation is over, to compare the alter'd Subject with its original self; whereby we come to a knowledge of what has been done, or what Alterations are produc'd, in the Process.

31. Thus, in the present Case, if the Analysis be just, we have some Reason to expect, that the Waters may be separated into Air, mineral Spirit, common Water, Salts, Oker, and Earth; all which when separately examin'd, shall give us the physical Cause of the Properties, and Effects, naturally residing in, or producible by the Waters. And if these Principles, after having been once fairly separated, can be put together again, so as to recompose

a Water of the same Properties, and Effects with the natural Water: there will hence be gain'd a high degree of Confirmation that the Analysis was just.

32. But the greater Advantages of our Analysis will be to show, and distinctly separate the natural Ingredients of the Water, without impairing their Virtues; determine what the Ingredients are; and, if possible, discover their Uses, not only to the Water, but also for the Purposes of Medicine, or other occasions of Life. Thus, for example, tho' it appears, by the foregoing Observations, that a saline Matter is contain'd in the Waters; yet we are by no means, hitherto, acquainted with its Nature, Properties and Uses. But these may appear hereafter, by means of the chemical Analysis, which we now proceed to.

EXPERIMENT I.

33. Four Pounds, Troy Weight, of the Purging Water, fresh taken up about the middle of December, 1733, being put into a very clean, and new Glass Retort; a proper Glass Receiver was immediately luted on, in the common manner, with a thin Paste of Flour and Water, spread upon brown Paper. The Receiver being placed in a Sand-Furnace, and work'd with a gentle Heat, so as just to make the Water simmer, we continued to distil, thus gently, till all the aqueous part appear'd to be come over into the Receiver, whilst a small Proportion of a dry Matter remain'd behind, at the bottom, and sides of the Retort.

34. As soon as the Retort grew warm in the Sand, numerous Bubbles appear'd to arise in the Water; and a volatile Substance seem'd, for a while, to puff faintly, like Air, thro' the luted

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ated Joint; the Luting being not yet dry'd, or harden'd, by the Heat.

35. When the Glasses were grown cold again, we took them asunder; and carefully weighing the Water that was come over into the Receiver; we found it to want scarce half an ounce of the original weight of the Spaw-Water at first put into the Retort.

36. We afterwards got the dry Matter out of the Retort; and weighing this also, found it to be about two drams.

37. By this Experiment, therefore, we find the Spaw-Water visibly divided into an aqueous, or fluid Part; one that is more fix'd, and dry: whilst a more volatile Substance seems to have escaped thro' the Luting, during the Operation.

38. To render this Experiment more instructive, verify some parts thereof, and gain farther Light, as to what Passages in the Operation, we made the following upon the same kind of Water, taken up at the same time.

EXPERIMENT II.

39. Two Pounds of the Purging Water being put into a very clean, and well-tinn'd, cylindrical Vessel of Iron*; which it nearly fill'd; we set the Vessel over a soft, clear Fire; and, by gentle Simmering, evaporated the Water to driness: observing, with a clean Ivory Spatula, to prevent any considerable adhesion to the sides and bottom of the Vessel. When about an eighth part of the Water was exhale'd, numerous, small, spangly Concretions appear'd, like Dust, on the Surface of the Liquor; and,

* A Vessel of Pewter, or Iron, well tinn'd, appears, for any thing we have found to the contrary, as fit for this purpose, as one of Glass, or Porcellane.

by

by degrees, more and more of a grain'd matter, resembling fine Drift-Sand, fell to the bottom; where, after a total Exhalation of the aqueous part, we found a dry, powdry Substance somewhat whiten than common powder'd Lime and not much unlike it to the Eye.

40. This Powder weigh'd, in a tender Balance, fifty-nine Grains; tho' a single Grain might well be allow'd for waste, in getting out of the tinn'd Vessel, to the bottom and side whereof a minute proportion manifestly stuck so that by this Experiment, the dry or fix'd Contents of the Water, were, at this time, the whole Water, in its natural state, as one Dram to two Pounds Troy; that is, as 1 to 192. Hence the present, and preceding, Experiment, mutually confirm each other, with regard to the proportion of the fix'd Remainder.

41. This fix'd Remainder was also the same in both Cases, excepting that in the latter it appear'd whiter, and more powdry, on account of being frequently stirred, and kept from sticking to the bottom, by means of the Ivory Spatula. And in all other respects, the two Experiments differ'd only as Distillation, and its natural Effects, do from those of simple Evaporation.

42. It was remarkable in this Experiment, by Evaporation, repeated a second and third time, for farther satisfaction, and illustration, that tho' the Water each time employ'd, did, when first put into the Vessel, strike a deep red, or purple, with Galls; yet it ceased to do this, after having felt a certain degree of heat; or after it was advanced about half way to the state of simmering, or boiling. So that what we call the mineral Spirit, or, more properly, the volatile Iron, in the Water, seems at this time,

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time, or with a scalding Heat, to quit the Body of the Water; according to what was also intimated in the Experiment by Distillation.

43. Upon comparing the two artificial Experiments, by Distillation and Evaporation, along with the natural Exhalation of the Water, by standing open to the Air and Sun; we shall find there is but little difference in their Effects*; or scarce any other than what is owing to the greater length of time required in the latter; whereby the saline part has an opportunity of shooting away from the earthy one; whereas, in Distillation, and artificial Evaporation, they appear to be more united, or mix'd together, at last; whilst in all the three Cases, as the aqueous part flies off, the earthy ones come closer together, and form little Concretions, like light Sand, or the icy cake on the top of the new made Lime Water; parts of which Concretions are continually separating, and falling down to the bottom; till all the moisture is evaporated; and a dry Substance, or Powder, is left behind.

44. This Powder, gain'd by means of Evaporation, over a gentle Fire, and constant stirring, feels somewhat rough betwixt the Fingers; but soon totally dissolves in the Mouth, with a remarkable bitter, saline, and roughish taste. It seems apt to relent, or run, in a moist Air; and makes a strong Ebullition with Acids; and powerfully destroys their Acidity. We procured a large quantity of it, as also of the aqueous part of the Purging Spaw-Water, by gentle Distillation; in order to make Experiments therewith.

* See above, § 20, 21.

EXPERIMENT III.

45. Two drams of the dry Powder, remaining after Evaporation over a gentle Fire, being put cold to two Quarts of common distill'd Water; a large proportion of the Powder quickly appear'd to dissolve therein; whilst a less proportion of it fell undissolved to the bottom. The Solution, after being poured off clear from the Sediment, tasted like the natural Purg-ing Spaw-Water that had stood for some time, and lost its Spirit; and five or six half Pints of this Solution being drank, as Spaw-Water, appear'd to produce nearly the same effects; especially with regard to the purgative quality; at the same time that alacrity, or briskness of Spirits which seems peculiar to this kind of Water; and is commonly supposed owing to the mineral Spirit thereof.

46. This Experiment, therefore, intimates that the Purgative Virtue of our Water principally resides in the fix'd saline part thereof, which will not evaporate by a boiling Heat; whence we are directed to a method of procuring this saline part, and separating it from the other Principles.

EXPERIMENT IV.

47. A strong Solution being made of this dry Powder in common distill'd Water, and filter'd thro' Cap-Paper, to keep out the earthy part, and transmit the Liquor perfectly bright and transparent, we afterwards exhaled it to a proper consistence, and set it in a clean Vessel, to shoot; whereby we obtain'd a quantity of pure crystalline Salt, to which we give, by way of distinction, the name of the *first Salt*.

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EXPERIMENT V.

48. The Liquor remaining after the first CrySTALLIZATION, being again evaporated to a due consistence, and set to shoot as before, affords a small proportion of another Salt, which we call the second Salt.

EXPERIMENT VI.

49. The Matter left behind in the Filtre, and in the Vessel, after the last CrySTALLIZATION, being well washed with common distill'd Water, to get out all the remaining saline particles; and then carefully dried, appears in the form of a whitish Powder, which we call *Earth*.

50. And thus, by the present Analysis, the Purging Scarborough Spaw-Water, seems resolvable into four sensible Principles; viz. (1) *an aqueous Fluid*; (2) *a first Salt*; (3) *a second Salt*; and (4) *an Earth*; and to these may be added, as less sensible, (5) *Air*, and (6) *a mineral Spirit*: upon each of which we shall bestow a particular Examination.

S E C T. II.

Of the aqueous Part of the Purging Spaw-Water.

1. IT was before observed*, that the Purging Water is, by Distillation, separable into an aqueous Part, and a dry Substance. The present Intention is to examine this aqueous Part, and to try whether it has any of the same Properties, or Virtues, as the original Water, or

* See Part II. Sect. I. § 33.

contains any real Principles, or Ingredients, thereof, more than common Water; in hopes of discovering its office, and uses, in this natural Composition.

2. To the Eye, this aqueous Part of the Spaw-Water appears not to differ, considerably, from the Spaw-Water itself, or from common Water; nor does it differ considerably from common distill'd Water to the Taste; provided the Operation was carefully performed, in clean Glass Vessels, with a moderate degree of Heat. But when attentively compared with, or tasted against, the natural Spaw-Water, fresh taken up from the Well, it is found to have nothing of the briskness, or pungency, the light Bitterness, nor mineral Flavour, of the natural Spaw-Water. And when compared with the same Spaw-Water that has stood, for some time, exposed to the open Air, it is found to want both the Bitterness, and mineral Flavour, of the latter. Nor can the Smell distinguish it from common distill'd Water; provided, as was said before, the Distillation has been carefully performed.

3. This aqueous Liquor being drank, in a considerable quantity, appears not to have the purgative, or other medicinal Virtues of the natural Spaw-Water: nor thus taken, does it seem to differ, in any respect, from common distill'd Water*.

4. So again, when examin'd by other Experiments, it discovers no considerable differences from common distill'd Water; for it neither turns red, or purple, with Galls, as the fresh Spaw-Water does; nor takes off the Acidity of Acids; nor alters the colour of Syrup of Violets; nor lets fall an Earth, upon the addition

* See above, Sect I. 13.

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of *Oleum Tartari per deliquium*; nor turns Milk to Whey, when boiled therewith; nor curdles, but lathers, with Soap; nor turns remarkably milky with the Solution of Silver; tho' some parcels of this aqueous Liquor have been found to do the latter, in a small degree. Its specifick Gravity also appears to be the same with that of common distill'd Water*.

5. Lastly, by all other kinds of Trial, in the way of Infusion, Decoction, Tincture, Elixation, &c. so far as they have been hitherto made, this aqueous Liquor appears not to differ, considerably, from common distill'd Water; or not more than one sort of common Water does from another; or than any pure and simple Water, that has remain'd mix'd, for some time, with the Ingredients, or Principles, of the Spaw-Water, will, after Distillation, differ from itself.

6. It therefore appears, upon the whole, that this aqueous Liquor differs, in numerous respects, from the natural Spaw-Water; and agrees so fully with common distill'd Water, that they may very well pass for one and the same Thing; or, in the Judgment of the Senses, for a kind of pure, *Elementary Water*; whence, for distinction sake, we shall hereafter call this aqueous Liquor, gain'd from the Spaw-Water, by that name.

7. Hence it is manifest, that the peculiar Properties, and Virtues, of the Spaw-Water do not reside in the Elementary Water thereof, as thus separated by Distillation; and consequently, that those Properties, and Virtues, must either remain in the dry Matter, left be-

* Compare this § with § 14, 15, 16, 17, 18, of Sect. I. Part II.

hind in the Operation; or have escaped, or been some way alter'd, or destroy'd therein.

8. That Air, and the volatile Mineral Spirit, escape in the Operation; we have already had more than a single Intimation* and shall hereafter enquire farther about it.

9. As for the dry Remainder, we shall soon proceed to examine its Contents; and if, upon the whole, the Properties, and Virtues, of the Water can fairly be made appear, by our Analysis, without supposing any Destruction, or considerable Alteration of Parts; the Law of a physical Enquiry will necessarily exclude any such Supposition. But if to this there can be added a Recomposition of the separated Parts, so as to form the original whole again, with all its Properties; the Matter will then be out of dispute.

10. Having, therefore, found that this Elementary Water has no particular Virtue, or Property, different from common distill'd Water; and consequently, that no part of the peculiar Virtue of the Spaw-Water depends thereon, any farther than upon common distill'd Water; we proceed to examine what is the office and use of this Elementary Water to the natural Water itself.

11. And here it is plain, from the Operation and the Thing itself, that the dry Substance left behind in the Retort, or after Evaporation, was once transparently dissolved, or kept undistinguishably suspended, in this Elementary Water; even after the Air and Mineral Spirit, if any such things there were, had made their escape. Whence it appears, that this Elementary Water is, naturally, a kind of Menstruum to the

* See above, Sect. I. 34 and 42.

whole,

whole, and of use to hold the parts thereof together, in a tangible fluid Form. But as this Menstruum is gradually drawn off, by Distillation, or Exhalation, from the grosser, or more fix'd, parts; these gradually approach nearer each other, and thus forming more bulky and ponderous Concretions, fall to the bottom, or stick to the sides of the Vessel, till, at length, the Menstruum being entirely separated from them, they appear in a dry, powdery state.

12. It might lead us too far from the present Purpose to engage in a particular Enquiry into the Nature, Properties, Office and Use of Elementary Water, in general; and shew how it is naturally fitted for a Menstruum, or Vehicle, to numerous Substances, which it occasionally carries along with itself, into the Vessels or Bodies of Vegetables, Animals, and Minerals; so as to promote their Growth, maintain their Bulk, and support, refresh, and recruit the Individuals, and produce many physical Effects, particularly in the Bodies of Animals, &c. and there is the less Occasion for this Enquiry at this present, because in our Chemical Lectures, we have endeavour'd to sum up this whole Doctrine, and set in a just physical Light*. We shall, therefore, here content ourselves with observing that this Elementary Water serves as a Vehicle to the rest of the Principles of the natural Water; so as to keep them dissolved, or finely divided in their Particles, yet blended together, in an uniform, compound, state; whereby the whole is fitted to enter all the Vessels of the Body capable of admitting them: whence the Mineral Water is fitted to produce its physical and medicinal Effects.

* See Chemical Lectures, particularly Lect. V.

13. And hence we have a farther Intimation that this mineral Water may, possibly, be no more than common Water impregnated with certain mineral Substances, which it meets with, and dissolves, in its Passage over particular Beds, or Veins, of Minerals, as it runs to the Well *. But the Confirmation of this Particular depends upon discovering that the Water, somewhere in its Course, is common Water, or till it arrives at a certain Spot, where it begins to change its nature, and acquire those particular Properties, Contents, or Virtues, which we find in the natural Spaw-Water; and that any other common Water may be thus impregnated by passing over, or leisurely draining thro', the same Beds: tho' our Enquiry does not hitherto reach so far.

14. But when the whole of this Affair shall come to be thoroughly examin'd, we may perhaps be thence enabled, in some Cases, to recover a lost Spring of mineral Water. That mineral Springs have sometimes been lost, or dried up, we learn from Natural History. Now if this proceeds from hence, that the Course of the Water is changed, or that it has found, or worn itself a new Passage, so as no longer to run over the Mineral Beds whereby it was before impregnated; it may be, sometimes, proper to try whether the Water cannot be derived into its former Channel: for if it can, and the impregnating Mineral Matters are not worn out, or exhausted, there may be reason to hope that the natural Water will be thus recover'd. Or if Water be wanting near the Place, it may be expedient to cast about, and try, whether a small Rill, or slender Rivulet, of

* See above, Sect. I. 25.

common Water, cannot be led from some adjacent Parts, and directed, over the same Beds.

15. But if a mineral Water shou'd be found to have lost its Virtues, and instead of being medicinal, shou'd prove no other than common Water; this might create a Suspicion, that the Minerals which before impregnated the Water are decay'd, worn out, or exhausted: Whence we are directed, either to supply those Minerals, by throwing fresh ones, of the same sort, into the Course of the Spring; or to lead the Spring about to new Beds, of the same kind; if any such are to be found adjacent.

16. And if there be any thing solid, or well grounded, in these Intimations; we may hence see the necessity there is for making a strict search into the Course of medicinal Springs; and becoming acquainted with the Beds, or Minerals over which they run: as by this means we may not only be enabled to prolong the date of a Mineral Water, or prevent its decay; but also to restore it when lost; and to make, alter, or improve Mineral Waters at pleasure. But this is a Subject that requires more Labour than has hitherto been bestow'd upon it; and if brought to perfection, might be a noble Reward to a diligent Enquirer.

SECT III.

Of the First Salt of the Purging Water.

1. BESIDES the Elementary Water, above examin'd, we shall find, by the present Analysis, that the Purging *Scarborough* Water contains (1) a neutral Purgative Salt; (2) an actual Sea-Salt; and (3) an alkaline Earth: All

All three left behind, in a mix'd State, after Evaporation, under the form of a dry, powdry Substance.

2. When this dry Substance is put to a proper proportion of distill'd Water, the greater part of it readily dissolves therein; whilst a smaller part falls to the bottom; leaving the Liquor greatly altered in Taste and Virtue, according to the Observations above delivered. And if the Liquor be now poured off clear, or be separated, by the Filtræ, from the grosser part; and more distill'd Water be boiled along with what falls to the bottom, or remains in the Filtræ; all the Particles that are thus capable of dissolving in distill'd Water, will be taken up thereby; and after another Filtration, and Drying, a fix'd Powder, incapable of dissolving in distill'd Water, be left behind. And thus, this first dry Substance will be separated into a part that is soluble in Water; and another that is insoluble therein; or into what the Chemists call a saline, and an earthy part: the saline part remaining dissolved in the distill'd Water, and the earthy part appearing in its own dry form.

3. But here a Difficulty may occur, or an Argument be raised against the Justness of our Analysis; "as if it had introduced a considerable Alteration, or actually produced this fix'd, earthy part; no Signs whereof appear, to the Senses, in the original Water. And the Argument may seem strengthened by this, that the Elementary Water, or common distill'd Water, will not now dissolve, or take up, the earthy part again, but lets it fall to the bottom; as having no affinity with it. How, therefore, cou'd this Earth

* See Sect. I. 43—47.

" make

“ make a natural, constituent part of the
“ Water?

4. The Answer is easy, provided we recollect what was formerly observ'd *, of an earthy Matter soon manifesting itself in the Spaw-Water; both upon a natural and artificial Evaporation; whence it appears that such an earthy Matter is naturally contain'd therein; but to render it visible, requires that a part of the Elementary Water be first separated; whence earthy particles coming nearer to each other; or, in the modern Phrase, within the Spheres of each others Attraction; they thus form grosser Particles, or Clusters, so strong as not to be broke, or have the Force wherewith they attract each other, over-powered by the lesser Force wherewith they attract the Particles of Water: But if once this Cohesion is broke by long Triture, or otherwise, and the earthy Particles be render'd extreamly fine, as they are in the natural Water, then they unite more readily with the particles of the Water, than with each other; and are thus easily kept asunder. Hence, to make the Elementary Water take up this earthy Substance again, we are directed to grind it fine; and unite it intimately with a large proportion of the Elementary Water. And by this means, not only earthy, but even metallick Bodies, are made to dissolve, transparently, in Water; viz. by reducing them to small particles, and lessening their Force of Cohesion. But this Affair may be farther clear'd up, when the earthy Part of the Spaw-Water comes to be examin'd: at present, we are chiefly concern'd with the saline one.

5. Some Gallons of the filter'd saline Solution above-mention'd being evaporated to a due

* See Part II. Sect. I. 20, 21, 39, 40, 43, 44.

Consistence, and set to crystallize for several days, we at length obtain'd a considerable quantity of a pure Salt, in the form of transparent crystals; which were afterwards carefully dried, in a shady Place.

6. We pick'd out a few of these Crystals, which appear'd to be the most perfect, or truest shot; and examining them, by the Eye, found they consisted of two broader, and two narrower Sides; each two being equal and parallel; but the former thrice the breadth of the latter. The two broader Sides terminate, at one end of the Shoot, in a small inclined Plain, forming a sharp Ridge; and the two narrower Sides terminate pyramidal, at the other end of the Shoot, in two small Plains, inclined the contrary way from the former, and rising also to a small Ridge, or Point. Two faint pyramidal Figures appear within-side the Shoot, the one rising from the flat, the other from the pointed end, as from a Basis; and striking out their Vertices towards each other: but neither of them reaches above a third part of the whole length of the Shoot.

7. In the Parcel, or Heap, this Salt, when perfectly refined, appears white, and shining, or glossy; almost like a Parcel of white Sugar-Candy: tho' when examin'd closer, the Shoots are more flat and Tape-like than in that. When a large quantity is made at once, some of the Crystals are usually as big as the end of the little Finger; and some much larger, so as to weigh several ounces. But the greatest part is commonly small, and flat; tho' perfectly transparent; and, when examin'd with a Microscope, of the same figure as the larger.

8. This Salt has no perceptible Odour; but tastes remarkably bitter; and pretty readily dissolves

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dissolves in the Mouth; at the same time seeming to penetrate deep into the Tongue, tho' without that nauseous, or disagreeable, Sensation, which is impress'd by *Epsom Salt*. It will also relent, or dissolve, by the Moisture of the Air; and is therefore best kept in a close stopp'd Glass, and in a shady place, which prevents its being turn'd white, and curdly, or having its transparency destroy'd by the Heat of the Sun.

9. When dry, it feels smooth to the Touch, and breaks, or snaps, with an audible noise, betwixt the Fingers; and when broke, does not appear fistulous, or hollow, like Nitre; but solid, and continued throughout.

10. Being laid upon a hot Iron, and held over a clear Fire, it soon melts, or appears in an aqueous form; then quickly rises, or swells, violently, and turns to a white, spongy, rarified Mass, or Calx: and tho' long detain'd in the Fire, does not change its nature, or run into Glass, like Borax; but still remains soluble in Water; and, by Crystallization, reducible again to Salt, of its own natural Figure and Properties; without any considerable loss. Whence it appears, that what the Salt loses, by this degree of Heat, is scarce any thing more than Water; as Water, alone, repairs the loss.

11. This Salt pretty readily dissolves in almost twice its own Weight of cold Water; thus making a bitter Solution, somewhat disagreeable to the Taste; but if more Water be added, the Bitterness is thereby proportionably lessen'd; so that, at length, the Liquor may be render'd as agreeable to take, bating for the Bristkness, which is here wanting, as the natural Spaw-Water which afforded the Salt.

12. A strong Solution of this Salt in Water turns white, or milky, upon the addition of a few drops of the Solution of Silver in *Aqua fortis*. But whether this proceeds from the nature of the Salt, or from some small admixture of Sea-Salt therewith, our Experiments have hitherto satisfactorily determined.

13. The other Experiments usually employed to discover Sea-Salt, do not manifest any considerable quantity thereof to be contain'd in the Salt; which makes no Ebullition, nor affords any perceptible Heat, Fume, or Vapour, upon the addition of Oil of Vitriol; tho' it should seem as if a quick Nose may here discover some small tendency towards the Odour of Spirit of Sea-Salt. It is also observable that the Salt itself crackles, a little, when thrown into the Fire. And hence we may be led to suspect, that a little Sea-Salt is mix'd along with it; especially, as we shall hereafter*; that it is naturally intermix'd with Sea-Salt in the Spaw-Water, and shoots in a Liquor where that Salt is certainly contain'd: whence some few Particles of Sea-Salt may easily adhere thereto. But this requires to be verified.

14. It may properly be called a neutral Salt, as it neither alters the neutral blue Colour of Syrup of Violets, nor makes any Conflict, or Ebullition, with Spirit of Vitriol, or other Acids; nor with Oil of Tartar *per deliquium*, or the Solutions of other fix'd alkaline Salts.

15. And yet this Salt curdles Milk, and turns the thinner part to Whey, by being boiled therewith; about the quantity of a Dram acting as strongly, in this manner, as near a quart of the Water. Nor does the Whey thus made with the Salt, common Water, and Milk, ap-

* See below, Sect. IV. 3, 4.

ear, in any respect, to differ considerably from that made with Milk and the natural Water. This Whey goes under the name of *Scarborough Whey*; and is found to be a soft, agreeable, purgative Liquor.

16. A quarter of an ounce of this Salt being dissolved in about a quart of common Water; the Solution, upon examination, appears not to differ from the natural Spaw-Water in any thing else but the want of the Chalybeate Spirit, a little Sea-Salt, and a due proportion of alkaline Earth. Whence we have an easy Method of making an artificial Water, resembling that of the natural Spaw, in some principal respects.

17. A quarter of an ounce of this Salt being dissolved in about six ounces of common Water, and drank as a Purge, by a Man in Health, of an ordinary Constitution; it began to operate in the space of an hour, and in half an hour after, gave four easy Motions downwards, without Gripping or Sickness; and without at all sinking the Spirits; but rather remarkably raising them; and, at the same time, proving considerably diuretick; after the manner of the natural Spaw-Water. And the like Effects have been found by several Persons, upon taking the same quantity of the Salt, or a little more, in the same manner.

18. And thus it has been found an excellent Purgative; far exceeding *Epsom Salt*, *Glauber's Salt*, *Sal Polychrestum*, *Tartarum Tartarizatum*, Cream of Tartar, Manna, &c. in costive Habits, and hypochondriacal Constitutions; as it does not, like the common Purgatives, tie up the Body, after the Operation is over; but leaves it free and open.

19. The Experience hitherto had of this Salt cannot be expected fully to manifest its Virtues;

as being a Thing not yet sufficiently brought in to Practice: but Trials enough have been made to shew that it is innocent; and, in many Cases, serviceable. We leave it for Physicians to determine, whether, from the short History here given of it, the known Virtues of the Water, and the Result of the present Analysis, this Salt may not be successfully used in the Dropsy, Jaundice, Obstructions of the *Primæ Viæ* and *Viscera*, the Gravel, Stone, and other Disorders of the urinary Passages; the *Iliac Passion*, the Cholick, Hypochondrical and Hysterical Disorders, obstinate Intermittents, the Scurvy, Rheumatism, Gout, &c.

20. From seeing the good Effects which this Salt has had, in some of these Cases, Mr. *Culmer Cockerill*, a judicious and experienc'd Surgeon and Apothecary at *Scarborough*, has been prevailed upon to make it, for Sale, under the name of the *SCARBOROUGH SALT*. The Water indeed affords it but in a small Proportion; and the Operation required to make it is tedious; whence it cannot be sold, quantity for quantity, so cheap as that called *Epsom Salt*, or *Glauber's Salt*: but, as the Dose of the *Scarborough Salt* is much smaller than of those; and its Virtues, so far as hitherto appears, incomparably greater; there will, upon the whole, be no great difference in the Price, dose for dose.

21. By comparing what is here related of this Salt, with the other parts of the present Analysis, it will appear that the purgative Virtue of the *Scarborough Spaw-Water* chiefly resides in this neutral Salt: for neither the Elementary Water; the second Salt, the Earth, the Air, or Mineral Spirit, are properly purgative; whence by obtaining this Salt, we have the purgative Substance of the Water highly concentrated,

centrated, or brought into a very small Compass; so as to be at all times ready, for making, in all Places, an artificial *Scarborough Water*, or *Scarborough Whey*; that shall not differ, considerably, from the natural Water, long kept; or from the Whey made on the Spot. For, by long keeping, the Mineral Spirit is lost to the Water; and in making the Whey, it is entirely dissipated by the boiling Heat, employ'd in the Operation.

22. Another Use of this *Scarborough Salt* may be to quicken, or increase the purgative Virtue of the Water occasionally, or where it shall be judged necessary; as by this means a small quantity of the Water may soon produce the Effect expected from a larger. And in some Cases, as particularly in Dropsies, and leucophlegmetick Habits, it may seem improper to drink freely of the Water itself; especially if it does not pass readily off; whereas the prudent Use of this Salt may so far quicken the Operation, and hasten the Discharge, as to render the Water beneficial, where it might otherwise prove pernicious.

23. So again, where Purgatives are necessary, in order to prepare the Body for a Course of the Waters; perhaps a more suitable Medicine cou'd scarce be used, for this Intention, than the *Scarborough Salt*. And possibly, in many Cases, it might be an excellent Substitute for the Water itself; as particularly in hot inflammatory Disorders, Hectical Cases, Ulcers of the Lungs, &c. where the Chalybeate, Mineral Spirit, naturally abounding in the Water, might be improper.

24. We recommend it to farther Trial, to discover the medicinal Virtues and Uses of this Salt, taken not in the way of a Purgative, but

as an Alterant, in small doses; in which quality we have some Reasons to expect it may be found eminently serviceable, in several stubborn, chronical Diseases; being used either alone, or along with other Alterants. But it is not our Design, at present, to be large upon this Head: tho' we hope to have dropp'd some improveable Intimations about the medicinal Virtues, and Uses, of this Salt.

25. The Kind of this Salt comes next to be consider'd; which must be determin'd by its Figure, Properties, and Effects. Its Figure, with some of these Properties and Effects, are mention'd above; and these may be sufficient to shew that this Salt is neither Nitre, Sea-Salt, Vitriol, Borax, Sal-ammoniac, *Epsom Salt*, *Glauber's Salt*, *Sal Polychrestum*, nor Dr. *Lifter's* calcarious Nitre; but, so far as hitherto appears, a Salt *in Generis*, and not properly referable to any known Species. But to make this fully appear, in the strict inductive Method, wou'd carry us too far from the Design of the present Analysis; which is only to open the Subject.

26. It seems owing to the particular Nature of this Salt, that it raises the Spirits, or gives a considerable degree of Alacrity, in Purging; which Effect, in the Water, is usually attributed to the Mineral, or Chalybeate Spirit, naturally contained therein. But as the Salt affords no Signs, upon examination, of its containing any Mineral, or Chalybeate Spirit; nor of any way participating of Iron; and yet has this Effect; it may hence be reasonably suspected, that it is not the Mineral Spirit in the Water, but the neutral purgative Salt therein, that produces this extraordinary Effect.

27. It was before observ'd, that the natural purgative Water has a bitterish Taste; and is found

found to grow more and more bitter in Evaporations, as the aqueous Part flies off, and leaves the saline Matter behind, condensed or brought closer together; whence, at last, the bitterness becomes strongest in the Salt itself. And as no bitterness is found in any other of the Principles, it hence appears that the natural Bitterish Taste of the Water (as well as its purgative, and diuretick Virtue; together with the Alacrity it gives in Purging) is owing to this same Salt.

28. The Use of this Salt in the Water, may, therefore, appear to be the rendering of it naturally Bitterish, Stomachick, exhilarating, diuretick, purgative, desobstruent, or cleansing; whereby the whole is the better fitted to be received by the Stomach, and to promote the natural Secretions and Excretions, open Obstructions, discharge noxious Humours, and carry it self agreeably off, without burthening Nature, or causing Sickness, Griping, or Uneasiness; as the common Purgatives of the Shops usually do; but, on the contrary, operating with a degree of Pleasure, and giving additional Vigour to the Body.

29. And as this Salt must be allowed the chief Principle, or Ingredient, in the Water, productive of these Effects, it may be accounted a principal Part of the present Analysis, to have found that this Salt is separable from the other Principles, and reducible to a dry, portable form, capable of preserving its Virtues unimpaired by Time, or Place; whence we are willing to hope that some Advantage may be derived to the Art of Medicine.

S E C T I V.

Of the Second Salt of the Purgine Water

After the first Salt is fully shot out of the filtered Solution of the dry Matter left upon the Evaporation of the Water, a salin liquor still remains behind, which being again evaporated to a due Consistence, and set to crystallize, for several days, there at length appears a very different Salt from the former, and in a much smaller Proportion, scarce exceeding an eighteenth Part thereof; the same variation happens in the proportions, according to the difference of the season, alterations of the Weather, or other Accidents.

This Second Salt, by the Figure of its Crystals, its Properties and Effects, upon Examination appears to be different from common or Sea Salt, as showing a crackling noise, cracking in the Fire, making a strong Effulvion, growing hot, and emitting a copious white pungent Vapour, with Oil of Vitriol; and manifesting itself to be Sea Salt.

When the Crystallization for the first Salt is hastily performed, it is not upon upon boiling the Liquor too high, or setting it to stand in too hot a Place, the second Salt is found to congeal and strike along with the other, so as to form irregular Lumps, or Clusters, having neither the Figure of the true Sea Salt, nor of Sea Salt. But it is easy to separate them from each other, by sufficiently diluting the whole with fair Water; and setting the Solution to crystallize slowly, in a cool Place: for thus the Starbough Salt will always shoot first, and

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leaves the Sea-Salt behind, dissolved in the Liquor, according to the Law of Crystallization, whereby the Salt that dissolves most copiously in Water, constantly shoots last.

4. But as there is no great difference betwixt the Scarborough Salt and Sea-Salt, with regard to their Solubility in Water, tho' Sea-Salt dissolves somewhat more copiously therein, this occasions a difficulty in obtaining the Scarborough Salt perfectly free from Sea-Salt, at the first Operation. And hence, as the Scarborough Salt is, in the Spaw-Water itself, naturally mix'd with Sea-Salt; and manifestly shoots in a Liquor considerably impregnated therewith, and more particularly, as they are both disposed to crystallize nearly at the same time; it may well be expected that the Scarborough Salt will participate a little of Sea-Salt, unless Care be taken to separate them thoroughly from each other, by repeated Crystallization, with the fresh addition of pure, or distill'd Water.

5. The dry Remainder, after a total Evaporation of the aqueous part of the Mineral Water, is found to make a considerable Ebullition with Oil of Vitriol, or other strong Mineral Acid; and as Sea-Salt is found to do the same, it might hence be suspected that this Effect, in the dry Remainder, is owing to the Sea-Salt it contains. But tho' the Sea-Salt in the dry Remainder may have some share in this Effect; yet, as it will appear hereafter, that the Earth of the Spaw-Water, even when thoroughly wash'd by repeated additions of distill'd Water, to get out all the saline Particles, will still make a strong Effervescence with Oil of Vitriol; this Effect must not be wholly attributed to the Sea-Salt contain'd in the dry Matter.

See Sec. V.

6. It would be unnecessary, in this Place, to enquire particularly into the Nature, Properties and Effects of Sea-Salt; tho' this be allow'd a Principle in the *Scarborough* Spaw-Water; as these are pretty generally known; and have already been touch'd upon in the first Part of the present Enquiry. It may be thought more necessary to shew that it is not an adventitious Thing, or a merely accidental Part, rather than a Principle, in the Water; as might be suspected from the adjacency of the Sea to the Well. But as Sea-Salt is found in this Water in all seasons of the Year, and at all times of the Tide, and appears naturally to exist inseparably from it, in its perfect State; we rather incline to make it a Principle, or constituent Ingredient; and as such proceed to enquire of what physical Use it may be to the Water.

7. It is a known Character of Sea-Salt to be preservative; or, in some degree, preventive of Putrefaction in certain Bodies; on which account it may be suspected that this is one physical Use of it to the *Scarborough* Water. But we have not hitherto had an Opportunity of verifying, or falsifying, this Suspicion, by particular Experiments. The purging *Scarborough* Water is known, by repeated Trials, to putrefy in Time, upon Stagnation, or being close confined in Glasses; so as to become extremely fetid, and alter in its Texture and Principles; tho' it will, at length, spontaneously, grow sweet, and potable again: But whether the Sea-Salt naturally contain'd in it, tends to preserve it sound, or prolong its perfect State, has not yet been made appear by direct Proof, or Experiment. It may here deserve to be mention'd that even Sea-Water, which is so highly impregnated with Salt, will still putrefy upon Stagnation,

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or close Confinement; after the manner of the *Scarborough* Spaw-Water; tho' it shou'd seem that this Putrefaction is, for some time, prevented by the Salt, or its natural, sound state protracted.

8. So again, it is presumed that Sea-Salt has the Power of quickening Purgatives, and acting as a *Stimulus* in the Body: but whether the *Scarborough* Salt has its purgative Virtue increased, or diminished, by a small admixture of Sea-Salt, we are not hitherto fully satisfied; but, on account of some Observations, and Experiments, incline to think that such an admixture rather lessens than heightens its purgative Virtue. A large addition of Sea-Salt certainly does so. Nor will that *Scarborough* Salt, which, in the making, remains considerably mix'd with Sea-Salt, operate near so briskly as the *Scarborough* Salt well refined, and thoroughly separated from Sea-Salt.

9. Reasons, chemical Experiments, and Observations are produced to shew that Sea-Salt passes unalter'd in its Nature and Properties thro' the Bodies of Animals; as being recoverable from the Blood, Urine, &c. in full possession of its Virtues; and reducible, by Crystallization, to its natural form. And as this Salt, in a moderate quantity, is also allow'd grateful to the Taste, or capable of giving an agreeable Relish to certain Liquids, at the same time rendering them more acceptable to the Stomach, and tending to prevent unnatural Changes, or the first Steps to Putrefaction, in the Body; it shou'd seem, that these are other physical Uses of this Salt, in the Water; as it may pass therewith thro' the several Stages of Circulation, and afterwards goes off unchanged, by all the Powers and Menstruums of the Body.

dy. But whether these Uses are rightly assign'd, must be determin'd by farther Experience.

10. And here we desire it may be kept constantly in mind, that tho' we sometimes propose Conjectures, and offer what may appear to ourselves, probable Reasons of Things; as presuming that they are founded in Observation, or Experiment; yet we esteem them, and desire they shou'd be esteem'd by others, no more than Attempts to discover Realities, or the Facts and Laws of Nature; without at all pretending, or even hoping, to have found them, till they are verified, and demonstratively proved to be so, according to the strict Rules of physical Induction. And in this Light we desire to have the present Analysis, and the intended continuation of it, consider'd. For its impossible, in the present imperfect State of Natural and Experimental Philosophy, to render a physical Enquiry into a copious and intricate Subject, perfect at the first Attempt.

11. And hence, tho' we constantly endeavour, as much as possible, to proceed in the Inductive Method; yet no solid Judgment can be form'd of the Nature, Extent, and Use, of the *Art of Induction*, from this rude Draught, or bare Beginning of an Enquiry; to continue which, with the desired Success, and bring it to a full Period, will require much more Labour of Thought, a greater number of Experiments, and a stricter Method of Reasoning, than those who are unacquainted with the Art of Induction, or the sure Method of pursuing physical Enquiries, can readily apprehend.

12. It was thought proper to give this Intimation, before we proceed to the more difficult part of the present Enquiry; where we shall not pretend to proceed with so much Clearness, and

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Certainty, (however little that may happen to be) as we have hitherto done; and this partly thro' a want of sufficient time for making the necessary Experiments; and partly again on account of the Subtlety of Nature; which will be found greater in the following Principles of the Water, than in those hitherto examined. Whence we shall, of course, be obliged to use more Reasoning than above, in order to trace this Subtlety, and contrive Expedients to follow Nature thro' her several Doubles; so as at last, if possible, not to miss of the End proposed. And here, perhaps, the Pleasure of the Chace may be greater than that of the Capture.

S E C T. V.

Of the Earth of the Purging Water.

1. W H E N the Earth of the Purging Water is perfectly separated from all saline Particles, by repeated washing in distill'd Water, and thoroughly dried; it appears in the form of a white Powder; and sometimes amounts to about one third of the whole quantity of dry Matter, left behind after a total Evaporation of the aqueous part of the Mineral Water.

2. This Earth appears to the naked Eye, as one simple Thing, somewhat resembling pulverized Talc. And when view'd thro' a common Microscope, a large part of it appears in the form of transparent Crystals, irregularly shot; some being long and slender, others short and rough; as if they were broke; or only small portions of larger, and more regular Shoots; and others again are so small as to resemble white transparent Sand: tho' the whole appears

appears to be more soft and downy than that: and accordingly it feels not harsh, but rather soft and silky betwixt the Fingers; yet, it is remarkably rough, and somewhat gritty, in the Mouth, or betwixt the Teeth.

3. This Earth, tho' of itself incapable of dissolving in Water, without some previous Operation, yet being added to Syrup of Violets, slowly turns that Syrup greenish; which gives an Intimation of a saline, alkaline disposition in this Earth. But a farther Confirmation hereto is afforded by the following Experiment.

4. Having pulverized a small Quantity of this Earth, we added an equal weight of strong Oil of Vitriol thereto; upon which a violent Conflict, or Ebullition, immediately ensued, and the Acidity of the Oil of Vitriol, soon appear'd, by the Taste, to be greatly diminish'd, or in a manner, destroy'd. But as the Oil of Vitriol was not here sufficient, without some farther addition of Moisture, to liquify the Earth, and come into full contact therewith, on every side; we put a suitable quantity of Water to the Mixture; whereby the Ebullition was, in part, renew'd, and a more perfect dissolution made; so that the Liquor being now tasted, no perceptible Acidity was found therein. Nay, it was hereby rendered so entirely neutral, that it no way alter'd the natural blue Colour of Syrup of Violets, or inclined it either to red or green.

5. And hence we have a manifest Proof, that this Earth is of a highly alkaline nature; at least with regard to Oil of Vitriol; the violent Acidity whereof it utterly abolishes, (like a highly alkaline, fix'd Salt;) and this even when their quantities are equal. But whether

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the Effect holds proportionably of all other Acids, we have not yet sufficiently tried.

6. That much weaker, and more aqueous Acid, Vinegar, seems to be an Exception; as the Acidity thereof is not so readily taken off by this Earth. But the Reason may be, that Vinegar, being so small an Acid, does not operate near so strongly upon the Earth, as Oil of Vitriol does; and therefore requires a greater length of time in order to make the Dissolution; especially if the Earth be not first render'd sufficiently fine, or reduced, to impalpable or invisible particles, thereby the better to prepare, and suit it to the Action of so dilute a Menstruum.

7. And this Suspicion may receive some kind of Confirmation from hence, that the Acidity of Oil of Vitriol, Vinegar, &c. is almost instantaneously destroy'd by the Spaw-Water itself; where the alkaline Earth is so subtilly divided, and perfectly dissolved, as presently to come into a full and free contact with the Acids, upon barely shaking the Mixture together: whereas, when the Earth is separated from the Water, it manifestly forms larger Concretions, Clusters, or Shoots, of a somewhat strong and close texture; so as not readily to be acted upon, especially in the more central parts, by Acids; whence a quick Solution, and intimate mixture cannot be reasonably expected.

8. But the justness, or insufficiency, of this Reasoning shou'd be made appear by particular Experiments; for otherwise, it cannot be safely relied on. And, with this View, it might be proper to reduce the Earth to such an impalpable, or subtil, State, as that it shall transparently dissolve, or remain permanently suspended in Water; so as not to appear distinguishable

guishable from it by the Eye; and thus to make the Experiment again, in order to discover if this artificial Mixture of the Earth and common Water, will not take off the Acidity of Acids, as fully and readily as the natural Spaw Water. But this Experiment we have not hitherto had the opportunity to make; and without it shall not pretend to foretel the Success: as in the Art of Induction, 'tis a primary Rule to investigate the proper Experiments of Information, and Proof, by reasoning up to them, and then leave the Experiments themselves, when made, to determine the Fact.

9. Thus much, however, has been found, by Experiment, that a rich and strong Solution may be made of this Earth, with Oil of Vitriol, properly diluted with Water, and poured, as a Menstruum, upon a suitable proportion of the Earth, first ground fine, or reduced to an impalpable Powder; and suffering them to stand together, in a moderate Heat. And this Solution, being afterwards set to shoot, in a cool place, beautiful Crystals of a certain neutral Salt have been procured: the Properties, Virtues and Uses of which Salt, may, possibly, deserve to be enquired after.

10. And tho' we do not, at present, intend to prosecute this Branch of Enquiry, yet, it may not be improper here to mention a Suspicion, or Intimation, afforded us by the preceding Experiment; as it may give some Light into a difficult Part of our Subject; viz. the Origin, or Generation, of the First Salt of the Scarborough Water. For, as there appears to be some affinity betwixt this Salt, and the neutral Salt obtain'd from the Earth of the Water, by means of Oil of Vitriol; this may intimate, that, possibly, the First Salt of the Scarborough Wa-

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ter, is a neutral Salt produced by the natural combination of a part of this alkaline Earth, with some certain mineral Acid: whose strength, or quantity, is so limited, as not to dissolve the whole; or no more than a determinate proportion of this Earth: so as still to leave the Water considerably alkaline.

That the Water is considerably alkaline has appear'd above: in so much, that an ounce thereof will quickly destroy the Acidity of a drop of strong Oil of Vitriol: but if a drop of this Oil be added to two ounces of the Water, the alkaline nature of the Water will only be destroyed in part, and the whole still remain alkaline in a less degree, or only half as alkaline as before. On the contrary, if two or three drops of Oil of Vitriol be added to a single ounce of the Water, the Water will appear to be acid, on taste, to the Tongue, and will then turn the blue colour of Syrup of Violets red.

Now the Cause hereof may be this, that, in the first Case, the Oil of Vitriol only lays hold of a part of the alkaline Earth contain'd in the Water, and so becomes neutraliz'd by that part, leaving the rest in possession of its more alkaline nature: the Oil of Vitriol being unable to neutralize more of it. But in the second Case, where a larger proportion of Oil of Vitriol is used, all the alkaline Earth appears to be neutraliz'd; and there being not now a sufficient quantity of this Earth to take off the Acidity of the Oil of Vitriol here employ'd, part of it remains unalter'd in its nature: so as to leave the Mixture acid.

And hence it appears, that the alkaline nature of the Water is entirely owing to this

See Part II. Sect. I. 15.

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predominancy of the alkaline Earth therein; or what may possibly be convertible with it, to the want of a sufficient proportion of Acid to neutralize all the alkaline Earth; and thus render the Composition neutral; or, if the acid predominated, art or flourish. For as a Grain of this Earth, (the quantity contain'd in about an Ounce of the Water) is, when separated from the other Principles, found, by repeated Experiments, to neutralize, or destroy the Acidity of a Grain, or Drop, of Oil of Vitriol; and as no other Principle of the Water is found to be of an alkaline nature, it follows that the alkaline nature of the Water is owing to the predominancy of this alkaline Earth therein; especially as the quantity of Earth separable from an Ounce of the Water, appears to have the same Effect, both in quantity and quality, upon a Grain of Oil of Vitriol, as an Ounce of the Water containing a Grain of the Earth.

14. This Point, therefore may seem, at least, tolerably verified: but it requires a deeper Search to discover whether the neutral, purgative Salt of the Water, be truly owing to the Solution of a part of the alkaline Earth, by means of a Mineral Acid. And this Particular cannot, perhaps, be fully clear'd, till it is shewn that a Mineral Acid, under some form or other, is to be found in the Water, or near the Course of the Spring, and actually mixes with the Water, or some of its Principles. For, if the neutral, purgative Salt, cou'd by Fire, be separated into a Mineral Acid, resembling Spirit, or Oil, of Vitriol; and into an alkaline Earth, resembling the alkaline Earth of the Water; as perhaps it may be, yet this would afford no certain Proof, that the natural, purgative Salt was originally form'd by a neutral Union

Union of the two. If such a method of reasoning as this should be allow'd, it would often betray us into Errors; as depending upon this precarious Foundation, that since Bodies are resolvable, by Art, into certain Parts, or Principles; therefore Nature composes Bodies by joining those Parts, or Principles, together. Indeed if Art were perfect, and cou'd exactly imitate Nature, in all Compositions, and Separations, this way of Reasoning might perhaps be just. But whilst Art remains so imperfect as it is; we are not to suppose, or imagine, but endeavour to find out the ways of Working employ'd by Nature. Nor does this, when rightly consider'd, at all clash with the Design of the present Analysis; as we do not expect to discover by it, how Nature originally form'd the Water; (which belongs to a higher Chemistry than we are here concern'd with) but to find into what distinct Parts the Water is separable, by ordinary Chemistry; so as to learn their Properties, Effects, and Uses, with a View to the Service of Man.

15. But if it shou'd once be made appear that a Mineral Acid actually mixes with the Water, in its Rife or Course; and that the neutral purgative Salt is produced upon this Mixture; then it might be a kind of philosophical Satisfaction, and an Instance of Power, to find that Art cou'd separate an apparently simple Body, into the two Parts, or Principles, whereof Nature composed it. And tho' we cou'd render it highly probable, by general Observations, Experiments and Reasoning, that there is an Acid, under different forms, to be found in the Bowels of the Earth, or near the Course of Mineral Springs; and shew how this Acid may be set loose, and enter the Body of a Water, so as
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to produce the Effect now under consideration; yet not having any positive Proof, of an Acid existing near the Confines, or Current, of the *Scarborough* Spaw-Water, we purposely decline the doing thereof in this Place; as being according to the Art of Induction, rather a sophistical Thing, than a real one; or tending to amuse, rather than inform.

16. There is another Intimation not to be here omitted, tho' no more than an Observation of what happens in making of the Experiments above mentioned, with the Purging Spaw-Water and Oil of Vitriol: as it may lead us somewhat farther in the present Enquiry, and afford an occasion of searching into the Origin, or Cause, of the Briskness of the Water. The Observation is this, that upon adding two or three drops of Oil of Vitriol, to three or four ounces of the Spaw-Water, and shaking them together, a remarkable conflict ensues; and upon tasting the Water, it now has a much greater pungency, or briskness, than before. And when the Experiment is made in a Glass Vial, and the Mixture is shook somewhat briskly, whilst the Orifice, or Mouth, of the Glass remains close stopp'd; upon opening of it again a considerable Explosion is suddenly made of a light Vapour, or subtile rarified Matter, like what issues from the Mouth of a Bottle of brisk *Potassium* Water, upon opening it after shaking.

17. Now, if what is above deliver'd concerning the alkaline Nature of the *Scarborough* Spaw-Water, and its Earth, be well consider'd; it shou'd seem, that this Effect is owing to the Earth of the Water, or produced by that, and the Oil of Vitriol, in the Act of Dissolution, or Intermixture: which may direct us to enquire

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quire whether what is called the quick Spirit, or Briskness, of the Water, be not naturally owing to some small Conflict existing therein, betwixt a latent Acid, and the alkaline Earth of the Water.

18. Our Experiments do not hitherto enable us to pronounce, either positively, or negatively, upon this Point; but so much seems certain, (1) that Oil of Vitriol dissolves this alkaline Earth, with a remarkable Conflict and Ebullition; at the same time generating, or extricating, a fine, light Vapour, or subtile Matter, resembling Air, which goes off in an explosive manner: (2) that the addition of a little Oil of Vitriol to the Water, makes it much more brisk, or what is usually called spirituous; provided so much be not added as to render the Water acid: (3) that this Conflict, whereon the artificial Briskness seems to depend, may be prolong'd, in some degree, or render'd considerably lasting, by adding the Oil of Vitriol to the Water, in a very small proportion, at due Intervals: and (4) that the like Conflict, and brisk or spirituous Taste, and explosive Vapour, may be made in common Water, for a great length of time, upon adding to it by turns, fix'd alkaline Salt, or Salt of Tartar, and Oil of Vitriol.

19. Laying, therefore these Instances together, it may, perhaps, be rationally suspected, that the brisk, or quick, and spirituous Taste of the *Scarborough* Spaw-Water is at least, in some measure, owing to a Conflict betwixt the alkaline Earth of the Water, and a latent Acid acting slowly therein; and thus continually dissolving the Earth into a neutral Salt, so long as the Conflict lasts, or the Acid can act as an Acid: after the Cessation of which Conflict,

the Water may soon lose its Briskness, or natural intestine Motion; and thus, upon Stagnation, or thro' a want of this silent Fermentation, enter a new State, or begin to corrupt, or putrefy. But this shou'd be esteem'd no more than a Suspicion, and a Hint for farther Enquiry, till direct Experiments are brought to confirm it.

20. The Experiment here principally wanted, is one that shou'd plainly shew there is an Acid actually contain'd in the Water; and yet that this Acid is of such a Nature, or so enveloped, as not to act powerfully, all at once, upon the alkaline Earth; as naked Oil of Vitriol does, when added to the Water; but slowly, silently, and by degrees; thus, in length of time, converting more and more of the alkaline Earth into neutral Salt; and at last ceasing to operate; either because its quantity, or strength, is overpower'd by the alkaline Earth, or because it has converted the whole of that Earth into Salt.

21. It was before shewn that Sea-Salt is naturally contain'd in this Water; and it is certain that Sea-Salt contains an Acid; or, to speak more strictly, that an Acid, called the Spirit of Sea-Salt, may, by Art, be readily separated from it; for instance, barely by the addition of Oil of Vitriol. Now, if, by any natural Means, the Acid of the Sea-Salt, can be separated in the Water, and slowly brought in contact with the alkaline Earth, a neutral purgative Salt may possibly thence arise, somewhat in the same manner as we see in the making of *Glauber's Sal Mirabile*; where the Oil of Vitriol gradually laying hold of the Earth of Sea-Salt, as the Spirit distils off; at length

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22. But before this Reasoning can have any weight as Evidence of the Fact, there are several Particulars to be consider'd, and several Experiments to be made; thus, for example, as there appears to be but a small proportion of Sea-Salt naturally contain'd in the Water; how can this afford a sufficient quantity of Acid, to produce a so much larger quantity of a neutral purgative Salt? And were the quantity sufficient, yet by what physical Means is the Acid separable from Sea-Salt in the Water? And tho' it were to be separated, will it certainly act upon the alkaline Earth; so as to produce a neutral, purgative Salt, like that of the *Scarborough Water*? Is this purgative Salt constantly upon the Increase, and the Sea-Salt upon the Decrease, so long as the Water continues in its brisk, or spirituous State, &c?

23. These Queries are not here propos'd as if we cou'd give satisfactory Answers to them; but with a View to intimate that there may, possibly, be a latent Acid, or the Matter of an Acid, contain'd in the Water; and that this Acid may possibly be slowly separated by the ordinary Operations of Nature, so as to answer particular purposes in the Water; without undertaking, at present, to shew what this latent Acid is, where it resides, or how it acts. That Acids may be latent in Liquors, till they find an opportunity of manifesting themselves, we learn from many Instances; as in Wine, Milk, Honey, Sugar, &c. wherein, at first, the Senses, nor even the more exquisite Experiments, can discover no Acidity; yet Wine by bare standing throws off an acid Salt, or Tartar, Milk turns

four, and Honey and Sugar, with Water and Warmth turn to Vinegar.

24. But we have still a farther View in this Procedure; for, having undertaken to shew something of the Art of Induction, or the Method of Enquiring into physical Subjects, but particularly into Mineral Waters; we would not willingly omit any Opportunity of illustrating this Art by Examples; and therefore chuse, on all suitable Occasions, to point out, as much as possible, the various Steps of Enquiry, and the several Workings of the Mind, necessary to the forming of a just Induction; being persuaded that if this Method were steadily pursued, in a suitable variety of Subjects, more and greater Discoveries might be made in Nature, within the Compass of a few Years, than by the common Method, in many.

25. We fear to have dwelt too long upon this dry Article of Earth; as it may seem to those who do not estimate Things philosophically; and shall therefore endeavour to dispatch, in a conciser manner, what we have for the present, further to say of it. And thus much seems to be fairly discover'd of it, that it is of a highly alkaline nature, and convertible into a neutral Salt with suitable Acids: whence it might be proper to enquire whether this Earth may not have some considerable Use in Medicine; and, on many Occasions supply the place of other less powerful terrestrial Alkalies, or those commonly called the Testaceous Powders. But, having not yet given it alone, to answer any curative Intention, we can only recommend it as a Thing worthy of Trial, from its obvious Properties and Effects; and particularly in certain Diseases of Children, which appear to be chiefly seated in the first Passages, and are judg-

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ed to proceed from a predominant Acidity in the Bowels and Juices.

26. It may, likewise, deserve a careful Examination, whether some considerable Effects of the *Scarborough* Spaw-Water, upon drinking it, are not owing to this alkaline Earth; as particularly, it's being found curative in Hecticks, serviceable in Consumptions, supposed Ulcers of the Lungs, Kidneys, &c. after the Mineral Spirit, or chalybeate Virtue, has been discharged, by open standing, or by a moderate Heat; provided the Water be drank, in such small doses, and at such intervals, as to prove rather alterative than purgative: which, possibly, is no inconsiderable Secret in the administration of this Water.

27. Again, we recommend to farther Enquiry, whether the great safety, and advantage, wherewith the *Scarborough* Spaw-Water is freely drank the next day after the plentiful, or immoderate, Use of Wine, or other spirituous Liquors, be not, in some measure, owing to this alkaline Earth; chiefly on account of its correcting the Acid which such Liquors are apt to leave behind in the Stomach, so as to occasion Nausea's, Sicknefs, the Heart-burn, Head-ach, &c. which are found to be soon remedied upon drinking the *Scarborough* Water.

28. If this alkaline Earth, given by itself, shall, upon competent Experience, be found to have considerable Virtues; it may then be proper to try whether the Water itself cannot be heighten'd in those Virtues, or render'd more efficacious in the Cure of certain Diseases, by a prudent addition or use of more of this Earth. And this should seem to be the more necessary in such Distempers as are attended with loss of Substance to the Vessels, or Organs, of the
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Body, great Wasting, and inward Decays, &c.

29. If, on the contrary, there are any Distempers, in themselves of an alkaline nature, where this alkaline Earth may be supposed improper; it is easy, according to what was above observed, by the prudent addition of a suitable Acid, to render this Earth neutral; and thus to accommodate the Water to the nature of the Distemper, even tho' Acids themselves were required.

30. An Objection, indeed, has been made to certain Mineral Waters, on account of their containing a large proportion of Earthy Matter, as if this were insoluble in the Body, and tended to generate certain Diseases, rather than cure them; as particularly the Gout, Stone, Asthma, &c. and a very plausible Argument might be formed upon this Supposition, without consulting Experience. But, as we hope to have shewn, in the Course of this little Enquiry, that no such Reasoning is of force, without Experiment; the Objection, so long as it rests in Reasoning, has no Right to an Answer.

31. All Waters, more or less, appear to contain an earthy Substance; and those, of the common kind, are allow'd the purest and wholesomest that contain the least; especially if it be of the hard, crusty, petrescent sort; which, tho' it might, perhaps, sometimes contribute to the generation of a stony, or tartareous, indigestible Matter in the Body; yet it should seem, that no valid Argument can hence be raised against a soft alkaline Earth, in Mineral Waters; or an Earth easily convertible into a neutral Salt (perhaps by the Acid naturally lodged in the Stomach;) and capable afterwards of acting as a dissolved innocent Salt, in the Body.

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And tho' it shou'd remain unalter'd therein; are not the solid Parts of Animals and Vegetables, formed of a real Earth? This Article of Enquiry may deserve to be prosecuted in the inductive Manner. But Medicine is hitherto little acquainted with the *Art of Induction*.

32. From the preceding Account of the Earth of the *Scarborough* Purging-Water, it may be suspected, that the Use of it in the Water is to render the whole properly alkaline; and fit for the Cure of such Distempers as require the assistance of Edulurants, or Sweeteners, as they are called; such, in particular, as the acid Scurvy, sharp Humours, ill Habits of Body, unsound Viscera, old Ulcers, Diseases consequent upon hard Drinking, many of the Diseases of Children; and in most Cases where a fine, or subtilized alkaline Earth is proper.

33. We do not, without farther Examination, pretend to determine the specifick nature of this Earth; or to say whether it be an Earth *sui Generis*, or referable to any known kind. In some of its sensible Properties, it seems to agree with Talc. But before its true Nature can be assign'd, its entire Figure, or Shoot, if it has any, should be found; the Salts it makes with different Acids examin'd; and the colour it gives to crySTALLINE Glass in Fusion; its Phænomena upon long Calcination; application to the Magnet, &c. noted. But these Experiments remain to be made; at least, in a more full and exact manner than we have hitherto made them.

34. But, besides this alkaline Earth, there appears to be another, separable from the Water, upon long standing, in the form of a Bolar Earth; containing, or affording by Fusion, a small proportion of Iron. But as this seems to

be no Principle of the Water, in its natural, found, or perfect State, and, not to exist, under that form therein, till the Water has undergone some considerable alteration, or begun to putrefy; we shall take no farther notice of it, in this place; as our present Design extends only to the Analysis of the Water in its found, or perfect state; leaving its putrefied state, and its recovery from thence, to be examin'd hereafter.

35. For the same Reason, we here make no mention of a Sulphur, or actual Brimstone, in the Water; as this is not discoverable therein till after Putrefaction; which, possibly, may be found an Operation that generates, produces, or extricates Sulphur in the Water, somewhat after the same manner as inflammable Spirit is generated, or produced, by vinous Fermentation.

36. There is still another kind of Earthy Substance, which appears separable from the Water, in its entire, or perfect state, by an artificial Contrivance to concentrate the Mineral Spirit, or Irony Principle thereof, and perhaps reduce it from a volatile to a fix'd state; by the addition of powder'd Galls, or other astringent vegetable Substances, fit for the making of common Writing Ink, with Copperas, or the Vitriol of Iron. But this Irony Principle will come more naturally to be examin'd, under the Head of Mineral Spirit, to which it may properly belong; as appearing to exist under that form, in the natural, found and perfect Water. We, therefore, now proceed to the two less sensible Principles of the Purging Water; viz. Air and Mineral Spirit.

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S E C T VI.

Of the Air of the Purging Water.

1. AIR seems to be more or less, contain'd in all Water; but particularly the fresh *Scarborough* Spaw-Water abounds with it; allowing that subtile explosive Matter to be Air, which is plentifully discharged by this Water, (upon standing, for some time, under the exhausted Receiver of the Air-Pump) in the form of those generally called Air-Bubbles in Liquors; which kind of Bubbles are large in the Purging Water, and darted with considerable force from the bottom part of the containing Glass, to the Surface; whilst the Receiver remains exhausted by working the Pump.

2. So, likewise if a Glass-Vial be filled with fresh *Scarborough* Spaw-Water, and the Mouth of the Vial be inverted into an open cylindrical Glass, nearly filled with the same Water; the lower Glass being set in a Water Heat, the Water whereof does not reach up to the Vial; the Warmth will occasion the Air in the Spaw-Water to rise up into what is now the upper part of the Vial, and there collect into a large Bubble; whereby the proportion of Air contain'd in a certain quantity of the Spaw-Water may be nearly determin'd. But we attempted to make the Experiment, more satisfactorily without Heat, in the following manner.

3. We filled a common Quart Bottle with the Purging Water at the Well-Head; then immediately tied over the Neck of the Bottle a limber Bladder, which had first been well oiled on the outside, to render it more pliable, and fill

fill up the Pores; so as, if possible by this means, to prevent any escape, or avolation of a subtile Matter thro' the sides of the Bladder; taking Care also first to squeeze out all the Air it might contain, by drawing it, like a string, several times thro' the Hand. Having thus fix'd the Neck of the Bladder tight to the Neck of the Bottle; the Effect was, that, in a few Minutes; without any application of Heat, the Bladder swell'd, and appear'd as if it were near a quarter full of Air. And, in this state it remain'd for several days; during which we frequently compress'd the Bladder, beginning at the Neck of the Bottle, and twisted it upwards; so as to collect all the subtile Matter at the upper Part of the Bladder; where, at those times, it constantly appear'd to swell the Bladder into a round Ball, the size of an ordinary Orange; and had it been Water, wou'd have measured about a quarter of a Pint.

4. Hence it shou'd seem that a considerable proportion of a dry, subtile, Elastick Fluid is naturally contain'd, after a loose manner, in the Water; so as to be separable from it spontaneously; without any external Heat, more than that of the common Air, or Atmosphere; and that it even flies off from the Water with some degree of force; as being able to distend a Bladder whose sides are compress'd, or squeezed together, by the weight of the Atmosphere. In order to discover what this subtile Matter, thus collected in the Bladder, was; we prosecuted the Experiment somewhat farther.

5. After the Bottle and Bladder had continued for above a Week, in the state already described; by twisting the under part of the Bladder we squeezed the subtile Fluid, to the upper end, and there tied it up in the form of a round Ball;

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Ball; then taking off the lower String which fasten'd the Bladder to the Neck of the Bottle; we removed the Bladder, with its Contents. And now pouring some of the Water out of the Bottle, we added pulverized Galls thereto; but found it afford no purple Colour: which gave us some little Expectation of having obtain'd the Mineral Spirit in the Bladder; tho' we suspected, the subtile Matter here rose too soon, or with too small a degree of Heat, to be the Mineral Spirit, which appears to continue for some time in the Water, upon standing; and does not entirely quit it over the Fire, without a scalding Heat.

6. However, for farther Satisfaction, after having examin'd the Bladder, and found it's Contents elastick; we plunged it's Neck into common Water, where a little powder'd Galls had first been put; then taking away the Ligature, we gently squeezed the Bladder downwards, towards the Water, to make it discharge its Contents therein; not forgetting to keep the Water stirring, that it might, if possible, imbibe the subtile Matter: and thus having, by slow degrees, render'd the Bladder flaccid, or brought its sides close together, we took its Neck out of the Water; but no red or purple Colour ensued.

7. This Experiment, consider'd in all its Circumstances, opens a large Field for farther Enquiry; particularly with regard to the Mineral Spirit, which here seems to have escaped insensibly, and left us, as it were at Fault; being neither found in the Water nor Bladder: which affords us an Instance of the great Subtilty of Nature; and may put us upon inventing more suitable Expedients to detain, collect, or fix this Mineral Spirit, or bring it under the more immediate

mediate cognizance of the Senses. But this belongs to the following Section; at present we are chiefly concerned with the Air of the Water, which seems to have been separated, collected, and render'd palpable, by the preceding Experiment.

8. But this Experiment itself requires to be farther verified, varied, and extended; so as to shew whether the subtile Matter here collected be true and permanent Air; whether it be unmix'd with any thing else; whether it has a greater Elasticity than common Air; what is it's absolute, and what it's specifick Gravity; whether it be tinged with the Mineral Spirit; how it naturally comes into the Water; what Proportion it bears thereto; whether it be accidental, or a true Principle therein; whether it will not in time, be absorbed by it's own Water again, &c. for this and much more must be done, before we can have an Inductive History of this Ingredient of the Water. But the slender Enquiry we have hitherto made, falls short in these Particulars.

9. But, perhaps, the following Experiments added to those already produced, may enable us to make a just Distinction betwixt the Air and Mineral Spirit of the Water, and incline us to allow them both as Principles. For, having filled an open cylindrical Glass, with the fresh purgative Water, and put it under the Receiver of an Air-Pump, then exhausting the Air, in the usual manner, and keeping the Water in this State till it appear'd to emit no more Air-Bubbles. We afterwards took the Water out, and put a little Powder of Galls thereto; upon which the Water appear'd to change its colour, or turn purple, as strongly as before it was set under the Receiver. Whence it shou'd seem that the Mineral Spirit, or chalybeate Property

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perty of the Water, did not escape along with the Air-Bubbles here discharged by the Water; and consequently that these Air-Bubbles and the Mineral Spirit are two distinct Things, separable from each other; tho' naturally existing in the Water together.

10. And this Experiment, and Conclusion, may seem somewhat farther confirm'd from hence, that tho' the Chalybeate Mineral Water appears, by the common Experiment with Galls, to contain more of the Mineral Spirit than the purging Water does; yet by the Experiment of the Air-Pump, the Purging Water discharges more Air-Bubbles than the other; and accordingly, having fill'd a Quart Bottle with the Chalybeate Water, and fitted a Bladder to it, at the same time, and in the same manner, as above described*; the Ball of subtile Matter here collected in the Bladder, was not above one fourth part so large as in the other. This Experiment, therefore, if found constant, intimates that the Air and Mineral Spirit are two Things in the Water; and that where one is largely contain'd the other may be less.

11. And it is chiefly on account of this large proportion of Air, naturally contain'd in the Purging Water, that we rather incline to make it a Principle; for if no more Air cou'd be here discover'd than in common Water, or the ordinary Sorts of purging Mineral Waters, such as those of *Epsom*, *Dulwich*, *Acton*, &c. (which are found to contain but little Air, or no more than almost any other aqueous Liquors) there cou'd be no just Foundation for making Air a Principle, or a more than ordinary Ingredient, in the purging *Scarborough Spaw-Water*.

12. Having,

12. Having, therefore, discover'd a Method of separating this Air from the Water, and collecting it, in a palpable form, distinct from the other Principles; we shou'd next proceed to examine its Properties and Effects; with a View to discover, whether it differs from the common, or atmospherical Air: but as we have hitherto made no considerable Progress in this part of the Enquiry; all that can fairly be said of it at present, is, that it appears to approach the Nature and Properties of common Air; and as such, we shall here consider its Use in the Water; referring, for farther Satisfaction, to future Trials, and our *Chemical Lectures*, especially the two that treat of *Water and Air*.

13. As, according to the Observations and Experiments above delivered, the Air appears to be under a State of compressure in the Water; so as readily to escape, upon the first Opportunity offer'd; hence this Air shou'd seem to exert a kind of struggling Motion in the Water; so as to keep the Particles thereof at a greater distance from each other, or render the whole specifically lighter, than after this Air has deserted it. And accordingly, the specifick Gravity of the Water appears to be considerably increased upon the Avolation of the Air; tho' the Mineral Spirit, perhaps, may still remain behind. But this also requires to be farther verified; as it might easily be by means of the Experiment made with a Bladder, tied over a very slender long-neck'd Glass, fill'd with the fresh Water; and finding the Surface thereof fall lower, when the Air is separated and collected in the Bladder; and presently removed from the Glass.

14. If this shou'd prove the Case, we might hence, perhaps, infer that one Use of the Air

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to the Water, is to rarify it, or render it more light and subtile, whilst detain'd, under its own form, therein. And this may seem a little confirm'd, from hence, that the Water, drank fresh at the Well, whilst the Air remains in it, appears to sit lighter upon the Stomach, and to fly up into the Head, and distend the Vessels, more than when it is drank after standing open for some time; whereby the Air appears to escape.

15. And thus, as Air is elastick, or has the Property of rarifying, or distending itself every way, with Heat; it shou'd seem that the natural Heat of the Body, by rarifying the Air contain'd in the Water, when drank fresh; widens the Passages; and thus renders the Water more subtile and penetrating; or enables it to enter such fine Vessels, as might not otherwise so easily admit it: whence the Water may be assisted in its Operation, and render'd more efficacious in opening Obstructions, and cleansing the finer Canals of the Body.

16. And if this Use of the Air in the Water be rightly assign'd; we have hence one Reason of the difference found betwixt drinking the Water fresh at the Well-Head, and after it has stood open for some time, so as to discharge it's Air. For tho' the Water retains it's purgative Virtue after the Air is gone; yet it seems not now to pass so far into the Habit of the Body, and produce all the same Effects, as when it is drank fresh, and replete with its natural Air and Spirit. Whence to have the full Effect and Benefit of the Water, it seems most advisable to drink it fresh at the Well-Head: tho' in some Cases, it is, doubtless, best to drink it after both the Air and Mineral Spirit are discharg'd;

charg'd; as particularly where the Vessels, or *Viscera*, are weak or unsound.

17. Another Use of the Air in the Water may be, to give it that Quickness, or Briskness of Taste, for which it is remarkable, when fresh; tho' this Effect, upon being fully enquired into, may perhaps be found to depend, not so properly upon the Air, as upon a certain physical Action in the Water, whereby the Air itself is produced. And here it may deserve to be tried, whether the artificial introduction of Air into common Water, will render the Water properly brisk, or pungent; like the *Pyrmont* or *Scarborough* Spaw-Water. For, if not, it may hence be suspected that Air, as Air, does not give Briskness to these Waters. And, indeed, there seems room to suspect, that Air, in this Case, is rather a Concomitant than a Cause; or that the Air is here generated, by the Action, or Operation, which is the true Cause of Briskness; as we see upon adding Spirit of Vitriol, or other Acids, to common Water, first made alkaline with Salt of Tartar, or the like*.

18. In the mean time, it may be suspected that the Air, or subtile Matter, whether naturally existing, or generated, in the Water, shou'd have some share in producing this Effect; as it may prove the Instrument, or secondary Cause, of an intestine Motion in the particles of the Water, by struggling among them, and endeavouring to escape; whence the Particles of the Water, thus agitated, may be more briskly impressed upon the Tongue, or made, in part, to fly off, and strike the olfactory Nerves. But this remains to be confirmed, or rejected, by particular Experiments: and we

* See above, Sect. V. 16—21.

here

here propose it only as a distinction that took its rise from Experiment, without asserting it to be just. It must also be left for future Experiments to determine, whether a part of the Air, still remaining in the Water, after the Air-Pump has acted upon it, be not a kind of Vehicle to the Mineral Spirit, or light Irony Substance; which afterwards gradually makes its escape, in the open Air, or all at once upon feeling a suitable degree of Heat. The Air-Pump is not found to extract all the Air contained even in common Water; nor does the Mineral Spirit, or Irony Principle, of the *Scarborough Spaw-Water* appear to be extremely light and volatile; whence in order to its escape, (if ever it does escape the Body of the Water; and not still remain therein, under a different form) it shou'd seem to require the assistance of some more volatile Matter than itself, to carry it off; or such an one as is capable of rising freely in the open Air, or with a certain degree of Heat, not much less than the Heat of boiling Water: which are Properties that may comport with Air. But this is only a Suspicion; which will, possibly, be somewhat farther countenanced; or falsified, in the following Section.

S E C T. VII.

Of the Mineral Spirit of the Purging Water.

1. THAT the purging *Scarborough Water*, besides the aerial Principle, naturally contains what may be called a Mineral Spirit, we have already had considerable Intimations; amount-

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ing, perhaps, when duly compar'd and weigh'd, to a sufficient Proof of the Fact: But what this Spirit is, how produced, how lodged in the Water, how alterable therein, and what are its Properties, Virtues and Uses, remains the Subject of farther Enquiry.

2. And as, in the prosecution hereof, the common Experiment with Galls is of singular Service; or a principal Thing whereon the Evidence of the Fact, and the other Experiments, relating to this part of the Enquiry, depend; it may here be necessary to explain and illustrate this leading Experiment, and endeavour to derive it from its true Principles: For tho' the Experiment itself be common, yet the physical Reasons of it seem to be little understood.

3. And perhaps the Foundation of this Experiment cannot be more satisfactorily learnt, than by carefully attending to the Process for making the common black Writing-Ink, with Copperas, Galls, and Water; after some knowledge is gain'd of the Nature of the Ingredients employ'd therein.

4. Common Copperas appears to be no other than an actual Vitriol of Iron, made from the Pyrites, or Vitriol Stones, which abound with Sulphur and the matter of Iron; at least the Pyrites are separable, by Fire, into an actual Brimstone, and an actual Iron; as into two principal Parts, whereof those Stones consist. And accordingly, a true Copperas, or Vitriol of Iron, like that commonly made at the Copperas-works, may be easily obtain'd from a fermented or burnt Mixture of Iron Filings, Brimstone, and Water; as also from Iron alone, dissolved in a weak Spirit of Vitriol, or the Acid of Brimstone*.

See *Chemical Lectures*, Lect. XIX. Exp. 3. and 4.

And

And thus, if the common Copperas were farther examin'd, in its Origin, Properties and Effects, it will appear to be a true Vitriol of Iron, generated by a dissolution of that Metal, or the Matter of that Metal in a Mineral Acid, such as is naturally contain'd in Brimstone, or afforded by it, upon burning.

5. Galls, on the other hand, are a natural vegetable Production, of the astringent, or styptick, kind; somewhat like Oak-Bark, tho' more rough, styptick and astringent than that; whence the Powder of Galls is found to be what the Chemists call a light Absorbent, or Precipitant; which, when added to metallick Solutions made with the Mineral Acids, acts somewhat after the manner of Salt of Tartar, Quicklime, or other alkaline Substance, tho' less powerfully; so as to weaken, or blunt, the Menstruum, and cause a slow Precipitation of the metalline Matter, to the bottom of the containing Glass.

6. Copperas readily dissolves in Water, and for some time, remains totally suspended therein; but, by degrees, its more ponderous metallick Part spontaneously falls to the bottom, in the form of a yellow, or orange-colour'd Powder, or Oker; which, by fusion, may be reduced to Iron again: but, for some considerable time, as was before observ'd, this metallick Matter is also suspended, and uniformly diffused thro' the Body of the Water; so as to make a transparent, and if the proportion of the Copperas be small, a pellucid Solution.

7. Powder of Galls, tho' it does not totally dissolve in Water, yet readily communicates its finer tinging parts thereto; so as, if the propor-

tion of the Powder be large, to make a high colour'd Tincture, or Infusion; which if sufficiently diluted, or weaken'd with more Water, may also be made to appear pellucid. And in this manner, two pellucid Liquors may easily be procured, which upon being barely mixed together, shall instantaneously turn to a kind of black Writing Ink, like the ordinary sort, made in the common manner by a warm Infusion of Copperas and bruised Galls in Water.

8. To discover the physical Cause of the Effect here produced, or the Reason why Ink is thus obtained; it will be necessary to remember what was above deliver'd of the Nature and Properties of the two principal Ingredients concern'd; viz. that Copperas is Iron dissolved by an Acid; whereby the whole becomes soluble in Water; and (2) that Powder of Galls, or the Infusion of Galls in Water, is an absorbent, or a mild Precipitant, with respect to metallic Solutions: Whence it may be reasonably suspected that, in the making of Ink, the finer Parts of the Powder of Galls coming in contact with those of the Copperas, a beginning Precipitation immediately ensues; or, in other Words, that the Particles of the Acid in the Copperas, which kept the Particles of Iron dissolved in the form of a compound or metallick Salt, being now weaken'd, absorbed, or attracted, by the Particles of the Galls, rather more than by the Particles of the Iron; hence these latter are somewhat loosen'd from their former Texture, or Combination, in the Copperas, and now appear in their own natural, opake form, or dusky colour; so as if numerous, to render the Mixture black; and disposed to let the heavier Mat-

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SECT. VII. *of the Purging Water.*

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ter, viz. the irony Particles, fall to the bottom.

9. But this shou'd be esteem'd no more than a Suspicion, till particular Experiments are produced to verify, or confirm it: thus especially it requires to be shewn that Iron alone may, without either Copperas, or Galls, be reduced to such a subtile Powder, as to keep suspended in Water, and constitute a black Ink, like the ordinary sort: for this ought to be the Case, if the Reasoning above be just; which supposes that Copperas is no farther of use in the making of Ink, than as it contains Iron subtilely dissolved, or reduced to fine Particles; whilst the Acid which reduced the Iron to this state has its farther Action upon it lessen'd or suspended.

10. And we have some Reason to believe, that the Experiment, when well made, might be attended with Success; or that a black Ink might be produced, barely by long grinding and digesting Iron and Water together; even tho' the Water shou'd be pure, or contain no acid or saline Particles; and tho' the Iron shou'd at first be clean, bright, or no way rusty. But as we have not brought this Experiment to full perfection, we do not here produce in direct Confirmation of the Theory above deliver'd; tho' we incline to think it might be carried so far as to shew, that the common Ink is little more than a Solution of Iron; and when dried in Writing, scarce any thing else but the Particles of Iron left upon the Paper.

11. That there is a tendency to Precipitation in Ink, may appear from hence, that if it be not thicken'd, or render'd somewhat glutinous, by the addition of Gum Arabic, Sugar-Candy, or the like, it is apt to deposite its irony Parti-

cles, in the form of a fine black ponderous Powder, at the bottom of the containing Glass; so as to leave the upper part of the Liquor clear or pellucid; and this tho' the Tincture of Galls is somewhat glutinous, or stiffening; whereby the Irony Particles may be longer suspended, or kept from falling readily downwards.

12. But it may here be objected, that allowing the Particles of Iron may remain long suspended, and uniformly intermix'd with Water; yet it seems questionable whether these alone can communicate so great a degree of blackness as we find in Ink; especially as the natural colour of Iron in the Piece, is far removed from blackness; or even after being reduced to fine Powder by Calcination, or Rusting. The Answer to this Objection seems in part derivable from hence, that Iron is much more subtilly divided in Vitriol, by the interposition of the Acid, than it is by Filing, Rusting, or Calcination: and that even Silver and Gold, when reduced to Particles of a certain degree of fineness, are black; as we see in the strokes drawn with them upon the white plaistry Leaves of common Table-Books. Nor, perhaps, is Ink itself, when properly examin'd, of so deep a black, as that it may not be reasonably supposed owing to the fine Irony Particles it contains; for if a small quantity of the blackest Ink be put into a very slender Tube of Glass, and viewed against the Light, it will appear not black, but almost as pale as common Water. But a more direct Answer to the Objection might be given; if Iron was once dissolved so intimately with Water alone as to constitute Ink*.

* See above, § 9.

13. Iron is of a very soluble nature, so as to dissolve in more Liquors than perhaps any other Metal; thus it is readily corroded and turned to Rust by standing in the open Air; and easily dissolves in many vegetable Juices; so as to form a kind of Ink; as appears upon the cutting of almost any Fruit with an Iron Knife. And thus rusty Iron readily makes Ink with the Infusion of Galls; and bright Iron also will do the same in a longer time, as we have tried: which nearly comes up to the Proof we want: where it may deserve to be remarked, that the Rust of Iron is a kind of imperfect Copperas, or Vitriol of Iron; as appearing to be made by some acid, or corrosive, Particles naturally floating in the Air, and falling upon the Iron; so as, in part, to dissolve, or turn it into Rust; which therefore is Iron open'd, and more disposed than bright Iron, to dissolve in Water, or to make Ink with a Tincture of Galls.

14. That Galls act as an Absorbent, or Precipitant, in the making of Ink with Copperas, may seem farther confirm'd by several Experiments; thus in particular, if the Powder of Galls be added to a mixture of Oil of Vitriol and Water, it appears remarkably to take off, blunt, or sheathe the Acidity of the Liquor; so as to render it less sharp upon the Tongue. Again, if a little Oil of Vitriol be added to common Writing Ink, not purposely made to prevent its being discharged, all the Blackness will be instantly destroy'd; and the whole Liquor appear pellucid, like fair Water; whence it shou'd seem, that the absorbing or precipitating Property of the Galls being now subdued by an over proportion of Acid; the irony Particles

are turn'd into Vitriol again; whereby the whole Liquor is reduced to the State of a weak or pellucid Solution of Vitriol, entirely wanting the Blackness of Ink. And on the same account it appears to be, that Ink-spots, or Iron-moulds, are taken out of Linnen by Juice of Lemmon, Juice of Sorrel, Verjuice, &c. as these acid Liquors dissolve the irony Particles, which, in that form, stick closely to the Linnen; and thus reduce them to the condition of a Vitriol of Iron; which will now readily dissolve, and be washed out by common Water.

15. And this seems farther countenanced from hence, that when Ink is turn'd to a pellucid Liquor, by the addition of Oil of Vitriol, or other Acid; the fresh addition of more powder of Galls, or any fix'd alkaline Salt, (so as sufficiently to lower the force of the Acid, or envelope its Particles) will instantly restore the Blackness to the Liquor, or turn it to Ink again; which, in this manner, may be several times discharg'd, and recover'd, in the space of a few Minutes.

16. Another Intimation that it is the Iron alone which constitutes Ink, may be derived from finding, upon trial, that no Acid, nor Oil of Vitriol, or Spirit of Sulphur, which with Iron constitute Copperas, will make Ink with Galls and Water: whence it seems a Consequence, that if Copperas be no more than a Composition of Iron and Acid*; it cannot be the Acid, but the Iron, in the Copperas, which makes the Ink; unless it can be shewn, or reasonably suspected, that the Acid acquires a new Proper-

* See above, § 4.

ty by the Mixture. But Oil of Vitriol is, by distillation, separated from Copperas, or the Vitriol of Iron, and found to possess the same Properties which it had before it was employ'd to dissolve Iron, for making the Vitriol. And the Remainder, or *Caput Mortuum*, as it is called, affords true Iron again by Fusion.

17. It remains to be farther observ'd, that no other Vitriol but that of Iron; not the Vitriol of Copper, or any other Metal which does not contain Iron, is found upon trial, to make a black Ink with the Tincture of Galls; whilst Iron dissolved in any mineral or vegetable Acid, is constantly found to make an inky Mixture with that Tincture; whence it shou'd seem to follow that Iron makes Ink.

18. But Galls are not the only Thing which makes Ink with Copperas, or Iron; since many other astringent vegetable Subjects are found capable of doing it; such, for Example, as Oak-Bark, Pomegranate Rind, Tea Leaves, &c. tho' always in a less degree, as they appear proportionably less absorbent, styptick and agglutinant. Since, therefore, no black Ink is found to be made without Iron, but may be made without Galls, it follows again that Iron is an essential Ingredient in Ink. And when all the Instances, both of the affirmative and negative side, (if any are producible on the latter) come to be well consider'd, we leave it to the Judgment of the Reader, whether Iron subtilly divided and suspended in Water be not what we call Ink.

19. And thus we hope to have shewn the Foundation whereon the common Experiment, of trying Mineral Waters with Galls, depends. We come now to apply it in examining the Mineral

neral Spirit of the Purging *Scarborough* Water; and in order thereto, wou'd draw this Inference from the Premises; viz. that as of all the Metals, Iron alone, and of all the Vitriols that of Iron alone, appears disposed to make a black Ink with Galls, or other astringent vegetable Substances; therefore, when any Liquor turns black with Galls, or such astringent Vegetables, this affords a considerable Intimation that a dissolved, or subtilized Iron, or the Vitriol of Iron is contain'd therein.

20. But to render this Experiment more useful and extensive, it shou'd be remember'd, that, as in the making of common Ink, the Liquor is, at first, pale and watery; but gradually grows more black by standing; as more of the Copperas and Galls comes to be dissolved therein: so, in the examination of Mineral Waters with Galls, there may be different Degrees, or Shades, of Blackness, produced; according to the quantity of irony Particles they contain; from a lightish red, or faint Pink-colour, to a deeper red, a purple, or a black. Thus when bright Iron is put into a slight Tincture of Galls, and suffer'd to stand in the Cold; the Liquor remains, for some time, unchanged in its Colour; but successively and slowly alters, from a light red to a full purple, that ends in a jetty black.

21. And thus when Powder, or Tincture, of Galls is added to the *Scarborough* Spaw-Water, a faint Pink-colour is first produced; which, at length, usually ends in a deep purple, or a considerable degree of blackness. But as the Water does not always turn of a deep purple, or black, with the same proportion of the same powder of Galls; we have hence an Intimation that

that it has not constantly the same quantity of irony Particles; and this, tho' tried, with fresh Water, at the Spring-Head. And by means of this Experiment carefully made and varied, we may perhaps be enabled to determine the Seasons of the Year, and possibly the Times of the Day, or Night, when the Water most abounds with the Mineral Spirit, or Irony Particles.

22. But notwithstanding this Experiment may, when thoroughly understood and consider'd, afford a high degree of Evidence that irony Particles naturally abound in the *Scarborough* Spaw-Water; yet the Art of Induction teaches us not to rest in any single Experiment that is not fully demonstrative; and accordingly directs us to look out for farther Proof, or Confirmation. And such farther Proof or Confirmation seems, in some degree, procurable by barely prosecuting the same Experiment, in the following manner.

23. To several Quarts of the Water fresh taken up, we added an ounce, or more, of the Powder of Galls; stirring them well together; upon which a considerable degree of inky Blackness soon ensued. We let the Vessel rest for several hours, and found that the grosser Part of Powder of Galls, together with the Blackness, gradually fell to the bottom; where being fully settled, we poured off the Water that floated above it, and dried the Powder; which now appear'd considerably black. Whence it shou'd seem that the irony Particles of the Water gradually subsided, and remain'd intermix'd among the gross Powder of Galls; the Water which was poured off appearing very little discolour'd, or almost pellucid; as sometimes happens in the
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making of Ink, when the blackness falls to the bottom, and leaves the upper part of the Liquor clear *.

24. And hence it shou'd seem, that the irony Particles of the Water are not extremely volatile; as they do not thus appear to fly off at the surface of the Water, tho' exposed to the open Air for several days; the black Matter still remaining, unalter'd as to colour, at the bottom. At least we have here a clear Intimation that an irony Substance is precipitated from the Water by the Powder of Galls; in the same manner as if a small proportion of Iron, or the Vitriol of Iron, had been dissolved therein.

25. But if this be really the Case, we may reasonably expect to find some signs of Iron, upon examining the dry Powder, gain'd from the Water by Precipitation with Galls; and accordingly, having calcined, or scorched, a part of this dry Powder, in an earthen Crucible, over the Fire; we afterwards applied an armed Load-stone to the scorched Powder; and found that some considerable Particles of Iron rose from it, and clung to the Iron-Capping; as others did also to a Knife-Blade, that had been touched with the same Load-stone.

26. But, as it may be suspected that the Iron here attracted by the Load-stone, was owing to the Galls employ'd; because all vegetable Subjects are found, after due Calcination, to afford some Particles of Iron; we, at the same time, scorched some Powder of Galls, in the same light manner; but upon applying the Load-stone thereto, did not observe that any Particles of Iron were attracted: And this, possibly,

* See above, § 11.

because

because there was not a thorough Calcination made; the Intention being only to scotch both Powders alike. So that, if these Experiments hold, or shall appear upon farther trial to answer in this manner; a strong Intimation may be hence derived, that irony Particles are naturally contain'd in the *Scarborough Spaw-Water*, after such a manner as to be fix'd by means of Galls, and a light Calcination; and reduced to the solid form of Iron. Tho' this Point also may be farther confirm'd, upon finding, as from some Trials it appears to be found, that a solid Lump of Iron is obtainable by fusing, with a strong Blast-Heat, a proper quantity of the Powder or Matter, gain'd, by Precipitation, from the Water.

27. Now, if these Facts shall, upon full examination, prove to be certain, or receive the Confirmation required by the Art of Induction; we may hence be led a Step farther in our present Enquiry, and proceed to examine (1) whether these irony Particles in the Water are not what may, in a due sense, be called its Mineral Spirit; (2) how this Spirit originally comes into the Water; (3) under what state it exists therein; as whether it be directly irony or vitriolick, volatile, or fix'd; (4) what Change it is liable to; (5) what are its Virtues, and what its Uses to the Water, &c.

28. It may seem to be satisfactorily proved, that irony Particles are naturally contain'd in this Water; so as to make a constituent part thereof; and as in its sound state, there appears to be no other direct mineral or metallick Matter contain'd therein, distinct from the saline and earthy Principles; we are obliged to make this the Mineral Spirit of the Water, if it be allow'd

allow'd to have any that may properly deserve the Name.

This true, this Name seems to imply, not only a great degree of subtilty in the irony Particles, but also a degree of Volatility; so as like the aerial Principle, easily to fly off, and quit the Body of the Water, whenever it has the opportunity. But whether it really does this, has not been made appear: so that, if the Iron contain'd in the Water be not volatile, but only finely divided, like the Iron contain'd in Ink, or other common Solutions of Iron; the Term Spirit may seem somewhat improperly applied thereto. Just philosophical Names can never be given to Things, till their Natures are known; whence farther Enquiry must determine whether the irony Particles in the *Scarborough* Water be a Spirit or not.

29 And, possibly, a careful examination of the Beds over which the Water runs, may intimate that this supposed Spirit is no other than a certain proportion of the finer matter of Iron or Oker, lightly dissolved in the Water. The great solubility of Iron itself, even in the solid metallick Mass, has been mention'd above; in-somuch that Ink may be made by barely suffering a lump of bright Iron to remain, for some hours, in pure Water impregnated with Galls.

And Naturalists find signs of Iron near the Confines of Chalybeate Mineral Waters; as in particular there are many such signs to be found near the Course of the *Scarborough* Spaw-Water: whence it seems rational to suppose that the Water becomes impregnated with its irony Matter by passing over certain Beds, or Veins, of soft Oker, or soluble Iron-stone. And if common Water, by being made to pass thro' the same Channels,

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Channels, shou'd be found to be thus impregnated; this might amount to a kind of Confirmation of the Suspicion.

30. But, to determine, with Certainty, under what form these irony Particles naturally exist in the Water, several Experiments will be required.

And the View shou'd here be directed to discover whether they exist under the form of Vitriol, or a mere Iron, subtly divided; and again whether under a considerably volatile, or a more fix'd State. If they existed in the Water under the form of a fix'd Vitriol, like the common Copperas, or Vitriol of Iron, it might be reasonably expected that the Vitriol shou'd thus manifest itself to the Taste; as Vitriol of Iron remarkably does, tho' but a very small proportion thereof be dissolved in Water: at least it shou'd manifest itself after the Water has been, for some time, boiled; so as to exhale a large proportion of the aqueous Part, and bring the particles of the Vitriol much nearer together; in the way of a strong Solution of Vitriol, capable of shooting in the Cold; as fix'd Vitriol is known to do. But no such Thing is found upon evaporating the Water; and therefore we may well suspect or conclude that it contains no fix'd Vitriol of Iron; especially as some hundred Gallons of the Water have been boiled to a small quantity, without finding any thing like this Effect.

31. So, likewise, if the irony Particles existed in the Water under the form of a volatile Vitriol; it might be expected at least when the Water is strong, or richly impregnated therewith; that this also shou'd be manifest to the Taste; whereas, when the Water is strongest, it does not seem to taste properly vitriolick, but rather

rather brackish, irony, or okry, with regard to the Taste of the Mineral. Nor do we remember to have met with such a Thing as a volatile Vitriol of Iron, capable of totally subliming with Heat; unless the *Flores Salis Ammoniaci martiales*, or Iron sublimed with *Sal Ammoniac*, may be so called.

32. Again, if these irony Particles are naturally volatile, whether vitriolick or not, it should seem that some certain Expedient might be used to collect, or detain them, so as to render them more manifest or sensible. That they are not extremely volatile, we have already had considerable Intimations; as they do not readily fly off in the open Air, nor over the Fire, without a scalding Heat. And that they do not quit the Water, and pass thro' the Pores of Glass, in many Months time, we are tolerably assured; by having known the Water kept in well-closed Glasses, for eight or nine Months, in a perfect State; so as to strike purple, or black, with Galls; apparently as strong as when fresh taken up at the Well. Nor does it seem probable, that these irony Particles shou'd escape thro' the Pores of a well oiled Bladder, where Air itself, a much more volatile Substance, is confined. And hence it might be proper to try, if this Mineral Spirit cannot be, some way or other, collected, in a separate State, from the Water, and the rest of its Principles.

33. With this View, the Experiment above described*, may be repeated, and diversified, with the requisite Care and Skill, to try, whether, after the aerial Principle has, by the Air-Pump, or otherwise, been in good measure discharged from the Water; and the Mineral

* Sect. VI, 3—6,

Spirit left behind; this cou'd not be made to rise, with a boiling Heat, and come over into the Bladder, as into a Retort; and there be collected; as the aerial Principle has been. So again, it might be tried, whether this Spirit cou'd not be brought over by distilling the Water in a common Glass Retort, into a Receiver containing the Tincture of Galls; which shou'd rise so high therein as to cover the Nose of the Retort; observing whether the Tincture wou'd thus, at the beginning of the Operation, turn black or purple. And many other Experiments of this kind might be contrived; but if none of them answer'd, it wou'd hence appear reasonable to conclude, that no volatile Iron, or volatile Vitriol, cou'd be obtain'd from the Water; and consequently an Intimation be gain'd, that none was contain'd, under a volatile form, therein.

34. These Experiments, when made, may be compared with those of a different kind, which shou'd tend to discover what Changes the Water undergoes, whilst it remains in Glasses sealed Hermetically, as it is called; viz. by melting or softening the neck of the containing Glass with Heat, then twisting it so as to confine the Water totally in Glass, without the assistance of Cork or Cement. Or, what seems as useful, and more instructive, in the present Case; the Water may be carefully bottled at the Well-head, then oiled at the top, after the manner of *Florence* Wine; and lastly, well cork'd and cemented. For thus the Water has been found to continue many Months possess'd of its irony Particles; even after being carried, (with Care to keep the Bottles upright) a great number of Miles. And by diligently observ-

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ing: what happens to the Water in this State, some considerable Light may, perhaps, be gain'd in the present Enquiry.

35. And since it plainly appears that the Water by standing, or by being carried, in this state, does not, for a very considerable time, lose its property of striking black, or purple, with Galls; hence it seems certain, that the irony Particles, or Mineral Spirit, of the Water, cannot easily escape thro' the Pores of Glafs; at least, not whilst the Water remains in a sound state: which is added, because when the Water begins to corrupt, as in time it will, even tho' thus secured; it tinges less and less with Galls; and at length, affords no red, purple or dusky Colour therewith. Whence we are led to suppose, either that the irony Particles, at this time, make their escape thro' the Pores of the Glafs, or of the Oil, the Cork and Cement; or else are so changed, as no longer to retain their irony Nature, and strike with Galls.

36. That the latter is rather the Case, seems countenanced by this, that during the Alteration, or Diminution of the tinging Faculty; there appears to be a manifest Change in the natural Texture of the Water; for a visible separation of Parts ensues; the whole grows fetid; a gross Matter falls to the Bottom; the Oil, that was liquid before, now becomes almost as hard as Tallow; and appears tinged black to a considerable height: but what is most remarkable, the Water now affords manifest Signs of its containing actual Brimstone; not the least Indications whereof appear'd before. And here is a Scene open'd which we are not, at present, to enter upon.

37. This

37. This Intimation, however, may seem afforded by the Premises, that the Water, as taken from the Well, is a compound Liquor, gradually tending to alteration in its Parts, as if there was a slow, and silent Fermentation among them; whereby the natural Texture, or Arrangement, of the whole is broke in time; even tho' the external Air be kept from communicating therewith; but if the external Air be admitted, remarkable Changes much sooner begin, and finish their Period. And hence, perhaps, it may be reasonably suspected, that the Mineral Spirit here suffers a change in its nature; or that the irony Particles may even be demetalized, and lost in their pristine form, or converted, at least in part, to Oker, Earth, or Sulphur; to which they, possibly, have a near Relation. But this is hinted only as Matter of farther Enquiry: for we are determin'd not to pronounce without clear and full Evidence; which we apprehend may always be had in physical Enquiries.

38. Supposing, therefore, the existence of fine irony Particles, in the natural and perfect *Scarborough* Spaw-Water; we now proceed to consider their Uses and Virtues; which seem, in good measure, derivable from the Art of Medicine, and the known Effects of chalybeate Preparations. And tho' these irony Particles seem to be few in the *Scarborough* Spaw-Water, with respect to the common Tinctures or Solutions of Iron, found in the Shops; yet they may have considerable Virtues; as appearing to be a natural Preparation of Iron, more subtle, exquisite, and homogeneous, than those of the artificial kind; as being mild, and made without any highly corrosive Menstruum. Whence

it might be proper to examine whether the softer Oker or *Minera Ferri*, which may be found in the Course of some Mineral Springs, is not capable of affording better chalybeate Medicines, than such as are usually order'd in Dispensatories. Perhaps a noble Tincture of Iron, or *Essentia Martis*, may thus be obtain'd.

39. The Experiment also may be worth the making, in order to discover whether common Water cou'd not be impregnated with irony Particles, after the manner of all Spaw Waters, by a bare Infusion of the *Mater* on *Minera Ferri* therein; at the same time observing what Alterations such an Infusion is subject to; by standing exposed to the open Air; and again upon being hermetically sealed up in Glasses. For if a separation of Parts shou'd quickly ensue in the former Case, and slowly in the latter; and the irony Particles at length appear to be turn'd into Oker, Earth, or Sulphur; this might afford a kind of Confirmation of the Suspicion above deliver'd, as to the change of the natural Spaw-Water, and the loss of its irony Particles, in their irony form, by standing.

40. The medicinal Virtues of a subtilized Iron are generally allow'd to be deobstruent, strengthening, or invigorating; at the same time that it is the most innocent, and wholesome of all metallic Substances; whence, perhaps, this subtilized Iron is no inconsiderable Ingredient in the *Scarborough* Spaw-Waters, as it may help to promote their other Virtues, or render them lightly chalybeate, without impairing the Virtues of the other Principles, or any way interfering, but rather conspiring with them. And if this chalybeate Virtue shou'd be required in a higher degree, we may be instructed by the present

present Enquiry, how to increase it in the Waters, by the artificial Introduction of a subtilized Iron into them. Or, if in any Case this Virtue shou'd be thought improper, as sometimes it may; 'tis easy to lessen it, by boiling the Water, or suffering it to stand open, or barely exposed to the Air, for some time.

41. We cou'd here subjoin several considerable Experiments, and Observations, with regard to this Mineral Spirit of the Water; and perhaps bring the whole Affair to a tolerable degree of Certainty: but to do this in so full and exact a manner as we cou'd wish, wou'd lead us too far from the present purpose, and engage us in the Analysis of the Water under a state of Corruption, or Putrefaction. We, therefore, choose to stop here for the present; with this Intimation, as a general Fruit of the preceding Enquiry, that, possibly, an exact and full Analysis of any Mineral Water, may lead to a clear, distinct and serviceable Knowledge of its different component Parts, or Ingredients; as also their respective Virtues and Uses. And thus, when the Analysis of the purging *Scarborough* Water is carried to its full length, and duly verified in all its Parts; this Water will, perhaps, appear to be a natural Compound, consisting of much fine Water; a variable Proportion of a certain neutral, purgative Salt; a little Sea-Salt; an alkaline Earth; Air, and a subtilized Iron; all mix'd together, under one certain Form or Arrangement; so long as the Water continues in its natural sound State. And hence it shou'd seem that the Medicinal Virtues and Uses of this Water, are derivable from such a full and exact Analysis; as depending upon the Virtues and Uses of the several Ingredients,

thus

thus combined together; provided we had a previous Knowledge of the true Causes of Diseases, and the nature, frame and make of the Body; so far, we mean, as this might be gain'd by the Art of Induction. But as this Art has hitherto been little, if at all, applied, to discover the real, internal Natures of the Solids, and Fluids, of the Body, the Changes whereto they are subject, and the true Seats and Causes of Distempers; no rational Attempt can hitherto well be made to determine the Medicinal Virtues and Uses of a Mineral Water *a Priori*, as it is called; tho' we had ever so exact and full a knowledge of the Contents of such a Water. And in this State the Matter appears to rest on the side of Medicine; whose highest Improvement may, perhaps, be rationally expected from the Art of Induction; as we hope hereafter to make more fully appear.

42. And thus we have gone thro' the imperfect Analysis at first proposed; and briefly consider'd the several Principles into which the Water has been resolv'd by its means; tho' without denying that there may, possibly, be others; or that these may be farther resolv'd, or render'd more simple. If this Work shall happen to be continued, 'tis hoped it may end in the Discovery of a sure Method of tracing out the Virtues and Uses of all Mineral Waters; and of procuring their Contents unalter'd in their natural Properties; so as to enable us to recombine the respective Waters from them; heighten their Virtues in some Cases; lower them in others; make artificial Imitations thereof; and thence improve the Arts of Pharmacy and Medicine.

T H E E N D.



Mineral Waters,

WHOLESALE and RETAIL,

Sold by JOHN FIDDES, at the Golden Wheatshaf in Tavistock-Street, Covent-Garden, London, at his Warehouse in the Savoy, and at his House in Scarborough; from all which Places he sends them to any Part of Great Britain, or beyond the Seas.



THE following TESTIMONIALS have been transmitted to the said John Fiddes; one from the Magistrates of Spa in Germany, which has the Arms of His Highness the Bishop and Prince of Liege, and the Seal of the Magistrate of Spa, as in the Margin; the other from Culmer Cockerill Esq; Senior Bailiff of Scarborough, and Dr. Shaw, Physician of that Place.



Nous les Bourguemaitres & Magistrat de SPA au Marquisat de Franchimont, Pays de Liege, Certifions que les 150 Bouteilles en un panier que le Sieur Alexandre Hay, Marchand a Spa, a fait Emplier pour envoyer a Monsieur Jean Fiddes, Marchand a Londres, ont été de bon tems & saison emplies a la bonne & veritable source des Eaux Minerales qui coulent en ce lieu accomodées par le ditte Hay & ces Domesticques, & cachetées du cachet ordinaire. En foi de quoi avons la presente fait sous-signer & cacheter par notre Greffier,
par Ordonnance G. STORHEAUX.

N. B. I have the like Certificate with every Parcel of Water.

N

THE



THE Pouhon Water of Spa, filled for Mr. John Fiddes, in Tavistock-Street, Covent-Garden, London; the *W*ind being North and freezing, and sealed with a Hand and bloody Toke; the Motto, FIDUCIA VICTRIX, and POUHON SPA, by me; ALEXANDER HAY.

N. B. Mr. Hay's House is adjoining to the Pouhon Spring; he having the best Opportunity of taking up the Water at the most proper Seasons.



WE whose Names are here subscribed do certify, That the Scarborough Spa Water, filled for Mr. John Fiddes, and sealed with the Corporation-Seal, is constantly taken up from the WELL at the most proper Seasons, and cemented down in the Bottles with a well-adapted Cement, according to our Directions:

CULMER COCKERILL.
PETER SHAW.



The said John Fiddes has settled such a Correspondence for the Pyrmont, Bath, and Bristol Hot Well-Waters, that he has them sent him fresh and in their greatest Perfection; which are sealed with their proper Seals, as in the Margin.

The Prices of the WATERS in London, delivered to any Part thereof, free of all Charges; viz.

German, Spa, and Pyrmont, at 14 s. per Doz.

Spa, Half-Flasks, at 10 s. per Doz.

Scarborough and Bath, at 7 s. 6 d. per Doz. and 4 s. per Half-Doz.

Bristol, at 6 s. per Doz.



N. B. The Scarborough Water is delivered at that Town to the Land-Carriers at 4 s. per Doz. and put on Board a Ship at 5 s. per Doz. All the other Waters may be had there at 2 s. per Doz. Advance for Carriage.



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